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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

The last month has been prolific of electrical conventions. First and foremost, the annual meeting of the American Institute of Electrical Engineers at Great Barrington was one of the most successful in the history of that progressive and, we are pleased to say, rapidly broadening association. Then the Northwestern Electrical Association held its summer meeting in Wisconsin jointly with the Wisconsin Telephone Association at which are represented all the independent telephone interests of that state. The annual convention of the Independent Telephone Association of the United States assembled at Philadelphia, a report of the proceedings appearing in this journal last week. The week before, the Association of Railway Telegraph Superintendents held its annual meeting. The month of June seems to be the period selected by the electricians of the country as the best time for their conventions. The National Electric Light Association, however, still continues to hold its well-attended conventions in the month of May, and the electric railway interests of the country convene every fall, usually in the month of October, this year in the city of Detroit.

ELECTROLYSIS.

The time is beginning to arrive when reckoning of a gigantic character is to be had between electric street railway companies and those who employ buried piping systems for various purposes.

When street railway systems were first installed, there was considerable difficulty found with the return currents which rapidly ate holes in buried pipes at points where they left the piping system to return to the power-house. The problem was taken up by the engineers of the various companies, and, in most cases, was solved by connecting the return system of the electric railway tightly on to the piping system at those points which showed rapid corrosion. This, of course, enabled the current to leave the piping system through metallic contact, and eliminated electrolytic action that formerly occurred there. This curing of the evil was only temporary. The current still remained in the pipes and traversed their length. As these pipes were buried in the surrounding earth at various degrees of conductivity, the current would not entirely stay in the pipe, but sometimes small portions of it were diverted through strata of more or less conducting powers, and particularly was this the fact around joints where the electrical conductivity of the metallic path was bad, and, as time went on, became worse, due to rust and oxides. This resulted slowly but very surely in a corrosion of the pipes which was general, and, though it took years for the result to be serious, it is beginning to be serious now. Reported damages from electrolysis are not now confined to local spots, but to entire pipe lines. As time goes on these damages will be great in extent and more frequently reported, and the money losses involved will be so large that the matter will be taken to the courts for adjustment. In the meantime it is well for electric railway companies to consider the permanent cure which has been frequently suggested, and which is practically the only effective means of stopping the damage forever. This is to keep the current out of the pipe systems. It has been found, and very naturally, that electrical damage was very much reduced by reenforcing the return feeder system, but it must not be forgotten that current delivered at a given point of the earth divides between various paths to the station, according to the law of shunts, and no matter how heavily coppered the legitimate return may be, a certain percentage of the current is bound to traverse parallel pipe systems as long as they present any conductivity whatever. It is, in fact, a beautiful illustration of the theory of limits. The current in the pipe system can, by means of increasing the ground return, be diminished to any quantity desired, to the limit of the financial ability of the corporation controlling the situation, but it can never be reduced to zero in this way. The remedy is to break up the electric continuity of the piping system by insulating joints. A single insulating joint will stop more current in the piping system than many thousand dollars worth of copper laid in multiple with it, and twenty or thirty properly distributed insulating joints will reduce the current in a pipe line more than an almost infinite amount of copper would do.

It is not the intention of these remarks to convey the idea that this fact has not been known or appreciated, for it is exceedingly difficult for a trolley company and a water company to reach amicable arrangements on this point. The work to be done is on the piping system. The damage comes from the trolley system. The question as to who shall do the work is of course one of some controversy, and in fact the installation of the insulating joints can be, and often is checkmated by the pipe company which will not allow the electric company to touch its system in any way, shape or form.

The overhead trolley system is an insti-

tution which can not be legislated out of sight, and although there is at present no legislation to cover the case, it is plain that after the trolley company has spent a reasonable amount of money to protect and reenforce its ground return, it can not be legally asked to do any more, and those who are interested in underground pipes will be obliged to install their systems in such a way as not to suffer damage from earth currents, which indeed may not be entirely due to trolley companies but to other causes as well. In the meantime the situation is full of controversy and legal complication, and it will be some time before it is definitely settled just what is the proper arrangement and who is to pay for it.

NEEDED ADDITIONS TO ELECTRICAL DATA.

In spite of the rapid advance of electrical engineering in all its branches and the reduction to definite formulæ available for the drafting room and workshop, of most of the useful physical phenomena involved, there yet remains much work to be done in certain lines to complete our practical knowledge and finish the line of data necessary to work out, without long experimentation, problems which often arise.

The solenoid or coil or plunger magnet is an example. If any data exist today by which the pull of an iron core at any given position in a coil may be computed they are hidden away in the archives of some manufacturing concern or locked up in the private records of some ungenerous investigator. Yet this is one of the oldest and most important of the electromagnetic devices being used in arc lamps, motor regulators, dynamo-voltage controllers, and in many other varieties of apparatus. So far as can be learned the various dimensions of core and coil, the resistances, number of turns and distribution have been determined in every case by lengthy and expensive experiments. It is claimed that satisfactory working formulæ can not be deduced for these appliances because of the large and indeterminate factor of leakage. This factor in the calculation of dynamo-electric machines is also large, and in the beginning was by no means definite, but it is now settled empirically with reasonable accuracy for each type of machine by means of tests on machines of various kinds. The mathematically inclined seem to be able to figure leakage by assuming hypothetical leakage paths and from their computed reluctance the stray field is calculated. In practice, however, experimentally determined factors are used, and we can see no reason why the same methods should not be applicable to the case under discussion. Another series of much-needed data relates to the drop of alternating currents in steel rails. The near future will undoubtedly see the spread of alternating-current traction and its application to situations which could not be profitably handled by continuous-current distribution. Inevitably the rails will form one leg of the circuit, both from reasons of economy and simplification of the contact and conducting devices. While it is true that some experiments have been conducted abroad—principally in Germany—and some approximations reached for a certain set of conditions, this field of research is practically untouched. Where can we find the formulæ or graphical methods which will give the relationships between area of rail, form of rail, frequency, wave form and drop, and the effect of the increased lag in one leg of the system on the practical working of the equipment?

This is work yet to be done, and which in time must be thoroughly investigated.

These are only two examples of the incompleteness of our data, and though we know much of the science there are many practical questions of importance which are yet to be definitely settled.

The Index of the ELECTRICAL REVIEW, vol. xl, covering the issues from January 4 to June 28, 1902, inclusive, is sent to every subscriber of this journal this week. The Index has been prepared with extreme care, and we believe the reader will find it of value. It should be preserved, as we can not undertake to supply extra copies. In the past there always has been a demand for such copies, evidently due to failure to preserve the Index when it was originally published.

THE SOCIAL SIDE OF CONVENTIONS.

The recent convention of the American Institute of Electrical Engineers at Great Barrington was marked by many social functions of a brilliant order, and the generous hospitality of the people of that city and of Pittsfield was so extended and attractive that it was impossible to give so much attention to the excellent papers which were presented as was desirable.

These conventions, however, can not be viewed as assemblages gathered together for the sole purpose of discussing scientific and engineering subjects. The social side is almost as important, bringing together, as it does, in friendly intercourse, men who would otherwise never have met, or who, if introduced to each other under other circumstances, would possibly never follow up the acquaintanceship.

No other single factor contributes more to the advancement of any science or profession than a personal, cordial relationship among all its members and an intercommunicated knowledge of the personality and intellectual attainments of the various human units which go to make up the complete fabric. Friendships are formed that lead to a friendly interchange of ideas which are developed and vitalized, resulting in a final crystallization into valuable additions to theory or practice. Business relations are made pleasant, new connections formed and the entire body works as a harmonious whole to the greater good of the art and benefit to the general public.

The value of the social side can not be estimated, but it exists, and to such a degree that it is ceasing to take the second place which heretofore has been allotted to it.

The demand for electrical engineers, graduates of our institutions of learning, is apparently increasing. "I graduated sixteen in my class in electrical engineering," said a college professor in this office last week, "and I had applications from electrical manufacturing, engineering and contracting companies for fifty-nine graduates."

Comment is unnecessary. We would only add that the apparent demand is for those graduates who have shown special ability.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XLIV.

BY W. ELWELL GOLDSBOROUGH.

In the discussion which follows, that magnetism which is set up by currents flowing in the armature coils of an alternator, and which permeates the field windings, will be taken as being due to an armature inductance factor called "the field inductance of the armature." We will designate it by the letter L_b. The corresponding reactance we will designate by x_b. Further, the lines of force which are set up by the armature current and which do not become linked with the coils of the field winding will be considered as due to the presence of a factor which we will term "the local inductance of the armature" and designate by the letter L_g, the corresponding reactance being designated by the letter x_g.

In commercial alternators, the inductances just discussed are not constant quantities, although they are usually assumed to be constant. As a matter of fact, they are variables which fluctuate in value with double the frequency of the electro-motive force and current waves developed in the armature winding.

In Fig. 160, we have a diagram

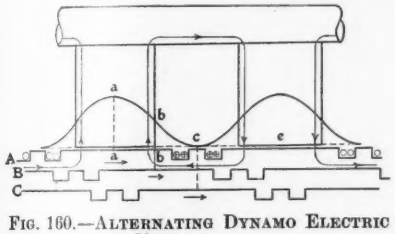


FIG. 160.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

which shows the character of the cyclic variation of the armature field inductance x_b. When the armature coils are in the position A, the centres (a) of these coils are at mid-points of the pole-faces, and their field inductance in this position may be represented by the ordinate (a, a). This ordinate will be the maximum ordinate of the field inductance curve, inasmuch as a movement of the armature in either direction to a position such as B will put the coils in a position less favorable to the setting up of magnetism around through the magnetic circuit, and consequently thereby reduce the amount of flux set up through the field circuit of the machine when a given current is flowing in the armature coils. In the position B of the armature, the centres of the coils are at (b) and the field inductance of the coils will have fallen to a value represented by the ordinate (b, b).

In the third position C, the armature has been so turned as to bring the centre of the armature coil to the point (c), which is midway between the adjacent pole-corners. In this position, the armature coils have no power to set up magnetism around through the magnetic circuit; consequently, in the C position of the armature coils, their field inductance

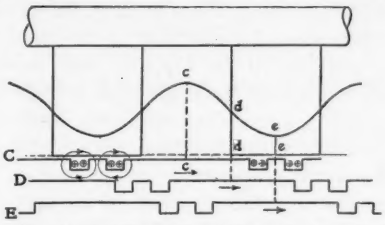


FIG. 161.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

is zero. If the armature is still further moved, as the centre of a coil approaches the centre of the next pole-face, the field inductance of the coils will rise, reaching its maximum value (a, a) again when the centre of the coil has arrived opposite the centre (e) of the new pole-face.

In Fig. 160, the curve which shows the cyclic variation of the field inductance of the coil has been taken as a sine curve, in view of the fact that most commercial alternators give an inductance variation which closely approximates such a result. The net effect of this variable inductance is to distort the shape of the current and electro-motive-force curves as the load

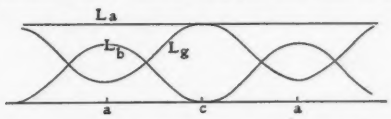


FIG. 162.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

comes on the machine. Were the armature inductance a constant for all positions of the armature relatively to the poles, the wave form of the current and electro-motive force would remain practically a constant for all non-inductive loads.

In Fig. 161, the (c) position of the armature so places the coils as to give them a maximum capacity for setting up cross-magnetization. The (c) position of

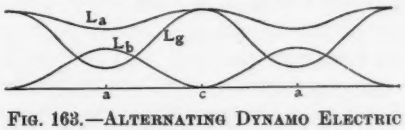


FIG. 163.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

161 therefore shows the coils in the position where their local inductance is a maximum. The centre (c) of the coil being midway between the pole-tips, we can lay off the ordinate (c, c) to represent the value of the local inductance at this time. A movement of the armature in either direction tends to lower the local inductance of the armature coils below the value (c, c). In the D position of the armature, for instance, the centre of the armature coil is at (d), and the local inductance has a value equal to only (d, d). A still further revolution of the armature to the position E brings the centre of the coils under the centre of the pole-faces, as shown at (e), and still further reduces the local inductance of the coils since now they are entirely from under the pole-tips, and therefore are least favorably placed as regards the ability of the currents in them to set up a local magnetic field about the conductors. In the (e) position, the local inductance of the coils drops to a value such as (e, e). We see, then, that in the case of both the field inductance L_b and the local inductance L_g of the armature, they are variables having a frequency of variation double that of the currents and electro-motive forces induced in the armature coils.

In Fig. 161, the local inductance curve (c, d, e) is shown as a sine curve in view of the close approximation to the sine wave of the local inductance characteristics of commercial machines. Variability in the local armature inductance has an effect similar to that of the field inductance as regards the changing of the wave forms from their no load character as the load comes on the machine.*

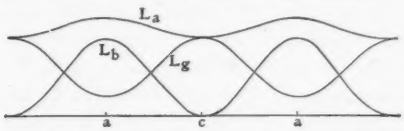


FIG. 164.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

The total inductance of the armature coils of an alternator is shown by taking the sum of the curves shown in Figs. 160 and 161. At times this summation is such as to produce a total armature inductance which is practically a constant for all positions of the armature relatively to the poles. For instance, in Fig. 162 are shown two curves. Considering the points (a) to represent the centres of the pole-faces, the point (c) represents the mid-point between adjacent pole-faces. The curve L_b represents the field inductance characteristic of the machine, and the curve L_g represents the local inductance characteristic of the machine. The sum of those two curves taken by adding corresponding ordinates gives the curve L_a, which is a straight line. This construction shows that it is possible to obtain a practically constant total inductance in an alternating-current armature for all positions of the armature relatively to the poles, and under all condi-

*Those who are interested in studying in detail the effects of variable armature inductance upon wave forms are referred to the Transactions of the American Institute of Electrical Engineers, page 303, vol. xiv, 1897.

tions of load, if the iron of the pole-pieces and the armature is not worked to the point of saturation. Where as the load is increased the iron of either the pole-pieces or the armature becomes heavily saturated, it produces an immediate effect upon the inductance characteristics and may either augment or diminish their value.

In Fig. 163, the point (*a*) represents the position of the pole-face centres as in Fig. 162. In like manner, the curve L_b is the characteristic of the field inductance of the armature, and the curve L_g is the curve of local inductance of the armature. In this case, the field inductance has been reduced relatively to the local inductance, as shown in Fig. 162. Taking the sums of the corresponding ordinates of the curves L_b and L_g of Fig. 163, therefore, gives us the curve L_a, which shows that, in this case, the total inductance of the armature is not a constant for all positions of the armature relatively to the poles, but is greatest when the centre of the armature coils lies midway between adjacent pole-corners. This is the common condition existing in commercial machines, where, as a rule, the local inductance is the dominant inductance factor.

In Fig. 164, the field inductance of the armature has been magnified relatively to the local inductance, and, accordingly, the sum of the curves L_b and L_g gives the curve L_a, which has a maximum value when the centres of the coils are immediately beneath the centres of the pole-faces. In making this study of the variable character of the armature inductance factors, it is well to note that the variations which take place in the total inductance of a machine are not, as a rule, so pronounced as the variations which take place during a half cycle in the component inductance factors. It is customary, as has already been said, in alternating-current working to assume that inductance factors are constants. This is usually done in the design, as well as in the discussion of such machines.

ARMATURE INDUCTANCE AND THE CHARACTERISTICS OF TWO-PHASE MACHINES.

In Fig. 165, a vector diagram is presented which shows the method of determining the regulation of a two-phase machine.

If one phase only of a two-phase machine is loaded, the load characteristic of the machine is developed along precisely the same lines as was the load characteristic of the single-phase machine shown in Fig. 135.

In Fig. 165 is presented a vector diagram similar to the vector diagram for the single-phase machine which is discussed in connection with Fig. 134 on page 212, since, when only one phase of the two-phase machine is loaded, the phase diagram representing the reactions occurring are precisely those used to show the performance of a single-phase alternator. Accordingly, if in Fig. 165 the vector OM_0 represents the magnetism set up by the field ampere-turns, under normal conditions of running, the cutting of this field by the armature conductors will produce a total internal electro-motive force E_0 equal to OA_0. Now, if the armature circuit is closed on a non-inductive load and this load is gradually increased,

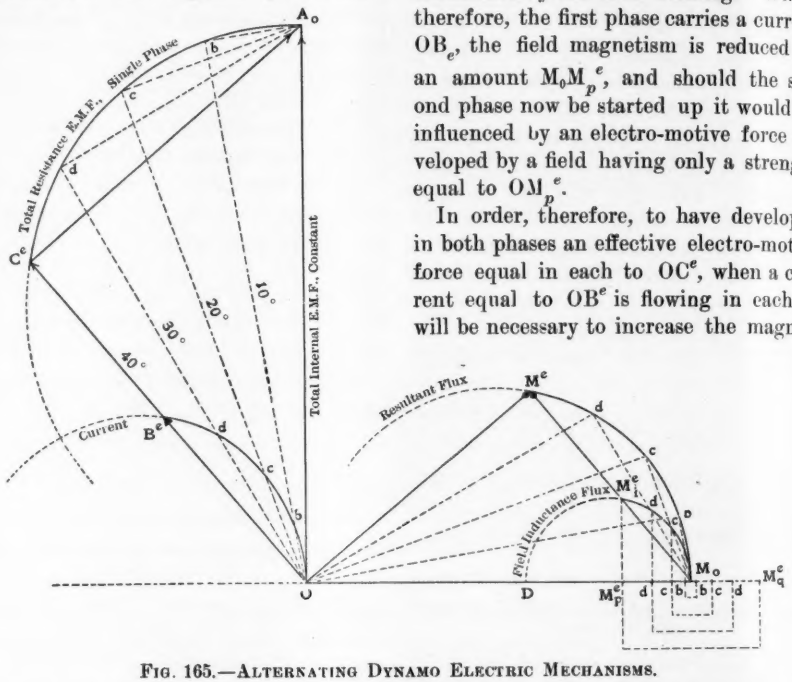


FIG. 165.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

a current will flow which will first have a value both in amount and direction represented by the current vector OB^b, and this vector will gradually grow until it reaches the value at full load of OB^e. As has already been explained at length, the magnetic reaction of this current is to set up a field M_0M^e, the vector resultant of which with the field OM_0 gives the final resultant field OM^e, which develops the electro-motive force OC^e, which is the total electro-motive force in phase with the current at full load for this phase.

The armature current OB^e, in developing the field represented by the vector M_0M^e, overcomes the armature reactance due to the field inductance and the local inductance of the armature coils. In so doing, it develops a flux which links with the field winding and is equal to the vector $M_0M_i^e$ or to the average field strength which results from the action of this current upon the field inductance of the armature L_b. Similarly, the armature current acting upon the local inductance of the armature, develops an average field strength which is represented by the vector M_iM^e. This field, however, is not linked in any way with the coils of the field windings. Accordingly, while M_0M^e represents the total effective field set up by the armature currents, only that portion of it included between $M_0M_i^e$ represents flux which reacts upon the magnetic circuit of the alternator, and, consequently, the projection of $M_0M_i^e$ on $OM_0M_p^e$ represents the total reaction of the armature currents in diminishing the total flux that is enclosed by the field winding. When, therefore, the first phase carries a current OB_e, the field magnetism is reduced by an amount $M_0M_p^e$, and should the second phase now be started up it would be influenced by an electro-motive force developed by a field having only a strength equal to OM_p^e.

In order, therefore, to have developed in both phases an effective electro-motive force equal in each to OC^e, when a current equal to OB^e is flowing in each, it will be necessary to increase the magnetizing power of the field winding sufficiently to counteract the demagnetizing field component $M_0M_p^e$. The addition of this much magnetizing power to the winding of the field circuit would provide for a total flux in the field circuit at no load equal to OM_q^e. Accordingly, if we consider that both phases of a two-phase machine are loaded gradually and non-inductively to exactly the same degree, and that it is desired to produce in each phase a regulation represented by Fig. 165, the magnetizing power of the field must be gradually increased so that as the load increases in each phase from zero to OB^b to OB^c to OB^d to OB^e, the total field magnetizing power will be increased in the ratio of OM_0 to OM_q^b to OM_q^c to OM_q^d to OM_q^e respectively. Such a procedure involves the operation of the generator under conditions which it would be hard to maintain in practice, even with hand or automatic regulation of the current in the field-exciting circuit.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—XXXI.

BY A. E. DOBBS.

SELECTIVE SIGNALING KEYS.

It has been explained before in this series of articles that telephone stations could be run selectively, either by the use of polarized bells or by the use of currents of varying frequency. In Fig. 131 there is shown, in the upper part of the figure, a representation of a four-party line with bells arranged for selective ringing. By the use of polarized bells, which operate by either a + or — current, it is possible to ring any one of four parties without disturbing any of the others.

Two of these bells, one responding to a positive and the other to a negative current through the "tip"—that is, the side of the line connected to the tip of the cord—are connected to the line as in any other metallic circuit. The other two bells, Nos. 3 and 4, are connected to the ground from the "sleeve" side of the line and are also actuated by positive and negative impulses delivered over one wire only; the subscribers in all four of these instruments talking over the line as a metallic circuit.

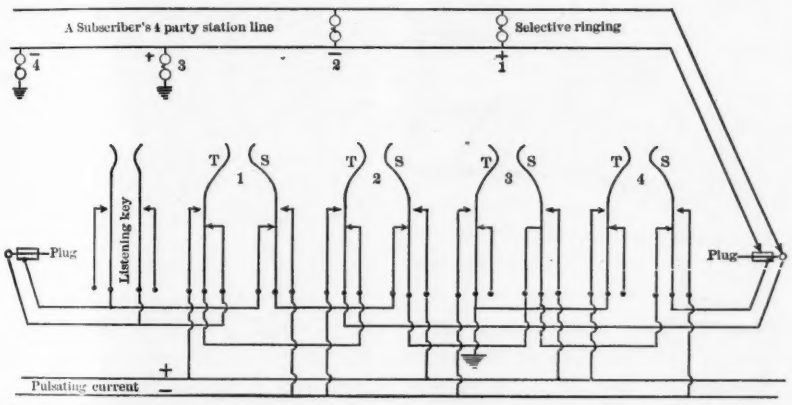


FIG. 131.—FOUR-PARTY LINE, WITH BELL ARRANGED FOR SELECTIVE RINGING.

The name "polarized," as applied to bells of this kind, does not accurately describe them, as all bells having their polarity fixed by permanent magnets—as are nearly all bells used in telephone work—are polarized.

Mr. Abbott's designation of bells that ring by means of + and — impulses as "biased" bells, is a much better descriptive word, as it indicates their function which is to respond only to impulses in one direction. In order to accomplish this the armature of an ordinary polarized ringer is given a "set" to one side by means of a spring. Taking it for granted that the bell is required to respond only to + impulses this "set" is therefore toward the negative side of the bell. Should a negative impulse pass over the line, the bell, being already held to the negative side of the ringer magnets, will not respond. Should a positive impulse pass through it, however, it will be pulled over toward the positive side of the magnet and pulled back again by the spring when released, thus giving the double stroke necessary in ringing.

On the other hand, if we desired the bell to respond to negative impulses the spring holds the armature toward the positive side of the ringer and is pulled toward the negative side by a negative impulse.

The listening key in Fig. 131 is bridged to line instead of being connected in series, as shown in Fig. 126, while the keys, Nos. 1, 2, 3 and 4, make the necessary changes in the polarity of a direct-current pulsating generator and throw varying currents to line, as may be required. These keys are generally arranged as push-buttons on the table in front of the operator, the plunger having a very small movement.

Thus we have four parties on a line, any one of whom can be called without disturbing the others.

To call No. 1 we throw a + current through the two sides of the metallic line while a reversed or — current calls No. 2.

With No. 3 we depress No. 3 key, which sends a + impulse over one side of the line through the bells Nos. 3 and 4, No. 3 only responding, and by reversing the current No. 4 responds while No. 3 remains silent.

It is also possible to place an ordinary alternating ringer of high frequency to this line and ring it by means of an alternating current, as the "biased" bells do not respond readily to an alternating current on account of the springs holding the armature to one side, thus making them slow in responding to a current of this kind with the result that they stand still and do no ringing that any one will pay any attention to.

If subscribers do not object to one and two-ring calls, the number of stations on one line can be doubled.

Lest some of our inventive friends might think it possible to place two more subscribers on the "tip" leg of this line, thus obtaining six calls instead of four, we might mention that the two bells, Nos. 1 and 2, bridge the two sides of the line together and by allowing the current to cross from one leg to the other would probably cause cross-ringing.

Competition for the "Galileo Ferraris Award."

The committee for the "Galileo Ferraris Award," which was instituted in 1898, being composed of the representatives of the executive committee for the General Italian Exhibition, held in Turin, in 1898, of the Chamber of Arts and Commerce, of the Royal Academy of Science and of the Royal Industrial Museum, in Turin, have determined to open an international competition for the award of this prize on the occasion of the unveiling of the monument to that illustrious scientist in Turin in the latter half of the month of September next.

The award is of 15,000 Italian lires ($2,500), together with the compound interest thereof accumulated since the year 1899 up to the day of the award, and it shall be granted to the inventor of some practical application of electricity, from which some noteworthy progress may arise.

Competitors may produce either pamphlets, schemes and drawings, or machines, apparatus and contrivances concerning their invention.

The jury, composed of the committee noted above, shall have full power to cause practical experiments to be made upon the inventions entered for competition, and upon the relative apparatus, contrivances and machines.

Competitors are to file their application and deliver their works, machines, apparatus and whatever appertains to their invention not later than 6 P. M. on September 15, 1902, at the office of the secretary of the committee, care of the administrative committee of the First International Exhibition of Modern Decorative Art, in the buildings of the Chamber of Commerce and Arts, 28 Via Ospedale, Turin, Italy.

Turin, April, 1902.

THE NEW GENERATING PLANTS OF THE NIAGARA FALLS POWER COMPANY.*

BY H. W. BUCK.

The growth of the applications of Niagara Falls power has been so rapid since the starting up of the first power-house in 1895 that the entire 50,000 horse-power of the first plant has been taken up to its limit. This growth was anticipated by the company three years ago, when the hydraulic development of a second plant was started under way. This plant is nearly completed and within a few months the first generator of its equipment will be performing useful work.

This power-house, from a popular standpoint, may be considered a duplicate of the old one, with which every engineer is familiar, and differs only in some of its technical details. It is located on the opposite side of the intake canal and nearer to the river, and has its water-wheels placed at the bottom of its own separate wheel pit. Discharge water is led out from this pit by a branch tunnel, which after leading independently for about 600 feet, joins the main tunnel, which, as is known, has a capacity of 100,000 horse-power. The new turbines are somewhat different from those in power-house No. 1, being of the internal discharge type and having the discharge water carried off through draught tubes, which add about ten per cent to the effective head. This increase in efficiency gives ten per cent more power for the same amount of water used in power-house No. 1, and in consequence the plant is laid out for eleven units of 5,000 horse-power each, instead of ten. The turbines were designed by Escher, Wyss & Company, of Zurich, and were built by the I. P. Morris Company, of Philadelphia. The governors were also designed by Escher, Wyss & Company, and are being built by A. Falkenau, of Philadelphia. They are of the oil-pump operated type and give a maximum variation of speed of about five per cent, with 100 per cent load variation, and for fractional changes in load the regulation obtained is about the same as that of a good steam engine.

The electrical equipment is furnished throughout by the General Electric Company. In general, its characteristics are the same as in the apparatus in power-house No. 1. The generators are of 5,000 horse-power each (3,750 kilowatts), wound for 2,300 volts, two-phase, twenty-five cycles at 250 revolutions per minute. This type was decided upon on account of its exact interchangeability with power-house No. 1. It was considered that the advantages which might result from winding the new generators for a higher voltage would be more than offset by the lack of interchangeability between two power-houses located so near together as to be governed by the same conditions.

Electrotechnically, power-house No. 2 differs in several essential details from the installation in the old plant, the differences being due largely to the advance of the art since the time when the first power-house was equipped. The main points of difference are:

1. Closer generator regulation, the regulation on the new machines being ten per cent and on the old ones about thirty per cent.

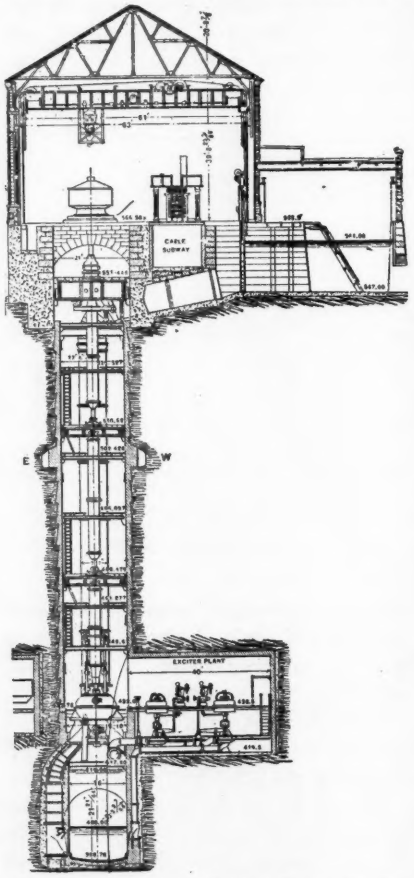


FIG. 1.—SECTION OF POWER-HOUSE NO. 2.

2. The entire plant will be operated from a single switchboard instead of two.

3. The feeders will be protected with automatic oil circuit-breakers.

GENERATORS.

The first six generators to be installed will be similar in outline to those in the first plant, being of the external field type, with the nickel-steel revolving magnet ring. This machine is shown in assembly in Fig. 2. In appearance the most striking difference is in the omission of the iron bridges over the machines. This omission results from the collector rings being placed at the bottom of the dynamo shaft instead of the top.

As above stated, the principal difference in these new generators is in the matter of regulation, the regulation being nearly three times as close. This closer regulation was adopted in order to ensure constancy of voltage on the system with variations in load and also to reduce to a minimum the unbalancing of the voltages on the different phases caused by difference in loads upon them. These points are of great importance on such a system as that of the Niagara Falls Power Company. Many electrical distribution systems are made up of a very large number of small consumers of power and the actions of any one customer have little effect upon the voltage of the system; consequently, in such cases regulation is not of such vital importance. But the Niagara Falls system is made up of a comparatively small number of very large consumers of power, any one of whom can, by a change in his load, cause a serious disturbance on the circuits. Furthermore, it is unique in one of its characteristics in that much of the power is used on large single-phase electric furnaces, which take their power from one phase only. Since it is impossible to control these furnaces so that at all times the same number shall be in operation from each of the two phases, inequality of load on the phases results and the voltages are unbalanced. This unbalancing is disastrous to polyphase, synchronous and induction motors on the system, for the high-voltage phase tends to carry all the load, and the windings on this phase are overloaded. These results can be rendered inappreciable only by the use of generators of close regulation.

The armature winding is a two-circuit series closed winding and consists of formed one-turn coils placed in open slots with two coils to a slot. The conductor is made of a stranded cable pressed into rectangular shapes. This stranding of the conductor reduces eddy current losses in the armature conductor itself which exist in the case of a large solid bar, as used in the old machines. The open slot is also considered an advantage in a machine of such great length of armature core, for in the closed slot it is necessary to drive the armature bar with its insulation on throughout the length of the slot in order to put it in place. The system used in the new machines of interlacing

*A paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers, Great Barrington, Mass., June 18 to 21, 1902.

the end windings gives strong construction to withstand the displacement strains caused by short-circuits.

The system of ventilation is radically different in the new machines. Referring to Fig. 2, a baffle-plate will be seen between the bottom of the armature winding and the bottom of the revolving field. This forces all the air which is actuated by centrifugal pressure to enter the machine at the bottom inside of the armature core, cooling the iron and the winding. It then continues outward radially between the layers of the field winding into an annular space at the back of the field coils and thence outward through holes in the magnet ring, which are bored in line with the pole-piece bolts. The action is that of a centrifugal blower caused by the rotation of the field-poles and ring. Some of the air also passes outward at the top of the ring through ventilating holes provided for the purpose. The operation of the air system is very satisfactory, and the blast of air secured is tremendous. From tests which have thus far been made, it is believed that these machines will run from ten degrees to fifteen degrees cooler than the old ones. These improvements in design were introduced by Mr. W. L. R. Emmet, of the General Electric Company, with the cooperation of Mr. H. G. Reist.

The generator equipment in this power-house is completed with five 5,000-horse-power machines of the internal revolving field type shown in Fig. 3. It was decided that the last five machines of the installation should be of this type on account of the much lower cost of building, simplicity of handling and accessibility to the various parts as compared with the external field design. These machines are also wound for 2,300 volts, twenty-five cycles, two-phase and operate at a speed of 250 revolutions per minute.

These machines will have the same regulation as the first six installed and in other respects the electrical constants will be the same. From the drawing in Fig. 3, the construction may be clearly seen. It is similar to the standard horizontal shaft engine-driven alternators of well-known types, and its method of ventilation is the same. Recent improvements in mechanical construction of generators have made this type possible at the high speed of 250 revolutions per minute, and improvements in water-wheel governors have made permissible the lower flywheel effect incident to this design, and the consequent omission of the nickel-steel ring of the first machines.

In the two power-houses, then, there will be three types of generator, but no trouble is expected in operating all the machines in parallel. As is well known, when two alternators of different regulation operate in parallel, the resultant regulation is the mean between the two. Idle current between the two types may be prevented by careful adjustment of the field currents.

The guaranteed efficiency of the external field generators was:

Full load.....98 per cent
Three-quarter load....97.3 per cent
One-half load.....96 per cent

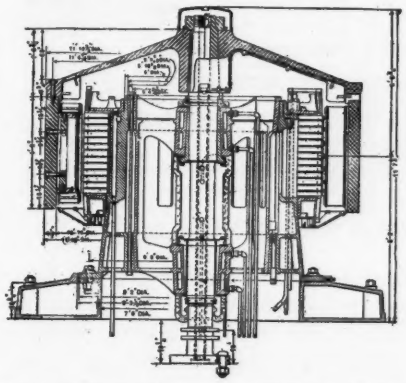


FIG. 2.—EXTERNAL FIELD 5,000-HORSE-POWER GENERATOR, POWER-HOUSE NO. 2.

From actual test the full-load efficiency has come out 98.15 per cent, which is probably the highest ever attained in an electrical generator.

EXCITER PLANT.

The exciter plant in the new power-house will be quite different in arrangement from the old one. The installation will be made complete with the exciter

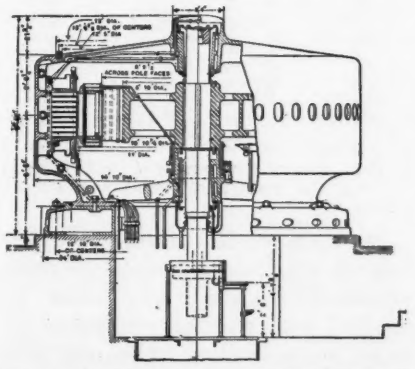


FIG. 3.—INTERNAL FIELD 5,000-HORSE-POWER GENERATOR, POWER-HOUSE NO. 2.

switchboard in a compartment recessed into the rock at the bottom of the main wheel pit, as shown in Fig. 1. This position will eliminate the long shaft necessary with exciters placed on the main dynamo floor and will simplify the operation of the plant. The equipment will consist of four 150-kilowatt compound-wound vertical shaft, 220-volt exciters, each coupled to an independent turbine, placed directly underneath. The speed is 750 revolutions per minute, and each exciter turbine is controlled by a separate governor. The exciter-plant wiring diagram is shown in Fig. 8. It will be seen that the power-house lights and auxiliary motors will be operated from this plant. A panel is also provided for interconnection with the exciter plant in power-house No. 1. The double set of bus-bars permits of the separation of exciting circuits and lights and motors. The exciter compartment will be directly connected by telephone with the main generator switchboard.

MAIN SWITCHBOARD.

As in all plants the most important element for successful operation is the layout of the switchboard apparatus. The switchboard in power-house No. 2 has been carefully considered and is believed to be convenient and as simple as it can be made and still accomplish the desired results. There has been a tendency in the design of some of the recent large switchboards toward complexity and the installation of unessential appliances which by their presence cause more trouble and confusion *per se* than they are intended to prevent. This has been avoided as far as possible in the design of this board.

Fig. 4 shows a plan of the power-house floor and the relative positions of generators, switchboard gallery, oil switches and cable subway. Fig. 6 shows a section through the oil switches and cable subway and indicates the location of the bus-bars placed in fireproof compartments. Fig. 5 shows a front elevation of the main switchboard gallery and controlling panels. The power-house is divided in respect to switching into two parts, one of six generators and one of five. Each part has its own group or oil switches and its double set of bus-bars. Fig. 10 shows the relations between the two groups and also the interconnections with power-house No. 1. All the switches in the new power-house are the General Electric electrically operated oil-break type of the well-known design. This switch is shown in Fig. 7. All cables are led through the cable subway. They are heavily insulated with rubber, covered with a fireproof braid and supported on brackets with porcelain clamp insulators.

The main switchboard consists of a gallery in the centre of the building, having mounted on it thirty-six separate controlling panels: eleven generator, twenty-two feeder, two interconnecting and one exciter panel. The relative location of these panels can be seen in Fig. 5, together

with their equipment. All the switching is done on these panels by means of relay switches placed in distinctive relation to one another and in such a relation to imitation bus-bars placed throughout the face of the switchboard that the connections are clearly indicated and no mistake in switching can easily be made. On the generator panels are two selector relay switches and one generator relay switch; on the feeder panels are two relay selector switches, and on the interconnecting panels are relay interconnecting switches for making the various connections between the two groups in the new power-house and between the two power-houses. On the sub-bases of the generator panels are dummy exciter bus-bars, with relay double-throw generator field switches. All these relay switches operate electrically the real switches out on the power-house floor and have the exact relation to the dummy bus-bars which the real switches have to the real bus-bars, so that even a green man could hardly make a mistake in throwing a switch. Return indicators are placed adjacent to the relay switches so that the operator may tell at once whether the real switch has responded correctly to the movement of the relay.

There has been a considerable craze during the last few years for the operation of switchboard apparatus by bench-board control, but in designing the board for this plant, the bench-board system, although carefully considered, was rejected as inconvenient. In the bench-board system, the operator in switching must first go to the bench-board and pick out the relay switch in question, then taking his eye off the switch, he must pick out from a concentrated mass of instruments in front of him on entirely separate panels, the instruments involved in the movement which he is about to make. This is not altogether convenient, and there is always a chance of a mistake. It is believed that the advantages of this bench-board system are more imaginary than real.

In the switchboard installed in this plant, each panel is a complete unit, and comprises all the apparatus, both switches and instruments, which are necessary for any operation which may be made upon it. So that when the operator goes to a feeder or a generator panel he has before him, enclosed within the limits of the particular panel, all the apparatus with which he is concerned at the time. All synchronizing will be done by means of a Lincoln synchronizer placed upon a swivel on the top of the switchboard.

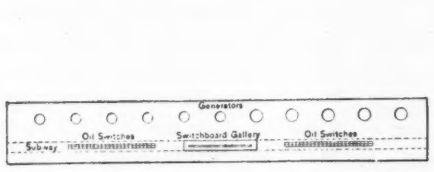


Fig. 4.—Floor Plan af Power House No. 2.

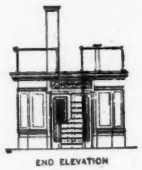
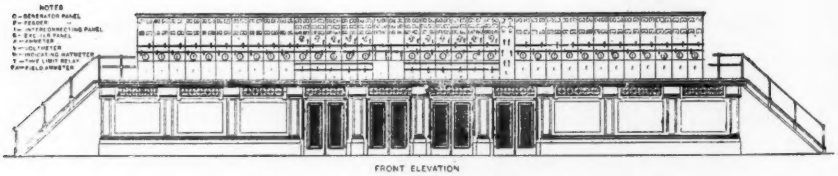


Fig. 5a.



Figs. 4 and 5.—Main Switchboard of Power-House No. 2.

The generator field rheostats and field switches are located under the main switchboard gallery. All feeders are equipped with recording wattmeters installed in the basement of the new office building, through which the outgoing feeders pass at the end of the cable subway.

It is the intention to operate the twenty-one generators normally in four independent groups, but the interconnections are so arranged that they may all be operated in parallel if desired, or any one generator may be thrown on any group. These connections are indicated in Fig. 10.

The feeder circuit-breakers will be operated by time-limit relays having an attachment devised by Mr. W. K. Gibboney, of the power company. A time-limit relay is a useful device for preventing a circuit-breaker from opening unnecessarily at times of momentary overloads, but if a real short-circuit occurs, it is objectionable. Experience has shown that on a system like that at Niagara, where there is a large amount of synchronous apparatus in operation, if a short-circuit occurs it must be disconnected at once, or else the prolonged drop in voltage will cause all of the synchronous apparatus to drop out of step; whereas, if the short-circuit can be disconnected instantly the inertia of the rotating parts of the synchronous apparatus will keep them in step for this short period. For this reason, the ordinary time-limit relay is objectionable, since it causes a delay. The device referred to above consists of a dashpot attachment to the tripping plunger of the circuit-breaker. This retards the movement of the plunger and consequently the opening of the breaker for ordinary temporary overloads, but if a real short-circuit occurs the pull on the plunger is so strong that the dashpot has no effect and the circuit-breaker opens instantly.

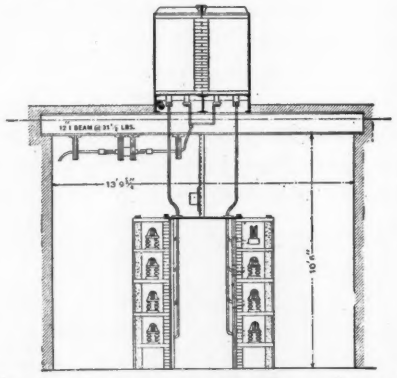


Fig. 6.—Section through Cable Subway under Oil Switches, Showing Bus-Bars, Etc.

THE CANADIAN PLANT.

Anticipating still further increase in the use of Niagara power, the Niagara Falls Power Company has, through its allied company, the Canadian Niagara Power Company, started work on its plant on the Canadian side of the falls. This plant will be located in the Victoria Park, about 1,500 feet above the Horse Shoe Falls. Its hydraulic feature will be similar to the American plants, with its intake canal, wheel pit and discharge tunnel leading to the foot of the Horse Shoe Falls. This power development will be used for the transmission of power to Toronto and other Canadian cities within transmission distance, and for the distribution of power to factories located in Canada in the neighborhood of the power-house. It will also be used for the supply of power to the American power system, with which it will be arranged to operate in parallel.

The essential difference embodied in this plant will be in the size of unit and in the electrical arrangements. The unit will be of 10,000-horse-power capacity (7,500 kilowatts), and the generators will be wound for 12,000 volts three-phase. The frequency will be retained at twenty-five cycles for the sake of uniformity with the American plants, so as to permit of parallel operation. In selecting this size of unit the American and Canadian systems were regarded as one. Since this is likely to reach ultimately an output of several thousand horse-power, a unit of 10,000 horse-power is not a large proportion of the whole and is not too large an amount of power to concentrate in one machine from the standpoint of convenience.

The principal advantage in a unit of this size over the smaller one is in the reduction in cost of development per horse-power. This reduction in cost results from—

1. Lower cost of generator per horse-power.
2. Lower cost of turbines per horse-power.
3. A 10,000-horse-power unit occupies only slightly more space than one of 5,000 horse-power capacity which results, for a given plant output, in great reduction in length of wheel pit, power-house and forebay and a consequent reduction in construction.

Other advantages will result, such as simplicity of operation, owing to the reduction in the number of units and reduction in the cost of maintenance. This size of unit was suggested by the engineers of the Niagara Falls Power Company and was adopted upon their recommendation. The generators, three of which have been

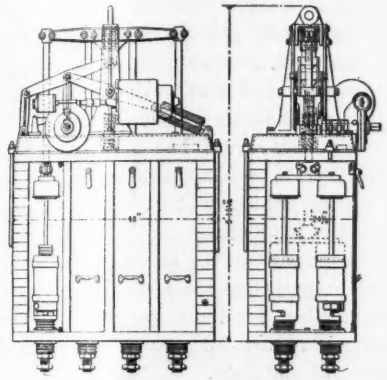


FIG. 7.—2,200-VOLT, TWO-PHASE ELECTRICALLY OPERATED CIRCUIT-BREAKER, POWER-HOUSE NO. 2.

ordered, are being constructed by the General Electric Company.

This generator is shown in assembly in Fig. 9. It is of the internal revolving field vertical shaft type. Its revolving field ring is built up of punched laminations bolted together with joints lapped. This method of construction gives a uniform and definite strength of ring and high magnetic permeability. On account of the high speed, 250 revolutions per minute, the generator is very small as compared with some of the large engine-driven units, its over all diameter being only about nineteen feet. The weight of the revolving part of the machine is 141,000 pounds, with flywheel effect at 250 revolutions per minute of 2,000,000,000.

The generators are wound directly for 12,000 volts three-phase instead of 2,300 volts two-phase, as in the American plants. This high voltage was selected, not for long-distance transmission, but for economy in distribution to power users near the power-house. In distributing large amounts of power underground from a 2,300-volt, two-phase plant, after a radius of about one mile is exceeded, it becomes cheaper to transform to 12,000 volts three-phase and distribute at this voltage than to supply power directly at 2,300 volts. From this it becomes evident that great economy results from the direct generation of the higher voltage. For

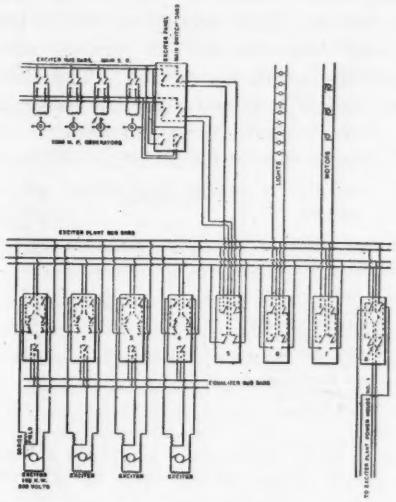


FIG. 8.—WIRING DIAGRAM, EXCITER PLANT, POWER-HOUSE NO. 2.

long-distance transmission step-up transformers will be used to raise the voltage to 22,000, 40,000 or 60,000 volts.

Fig. 11 shows the method which will be adopted for operating in parallel the American and Canadian systems. The

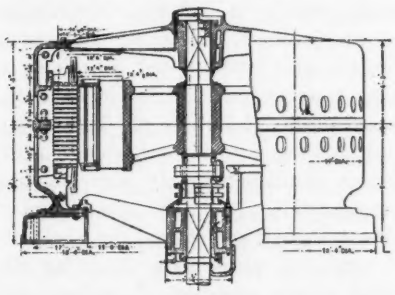


FIG. 9.—10,000-HORSE-POWER, 12,000-VOLT, THREE-PHASE GENERATOR, CANADIAN POWER-HOUSE.

connection will be made by triple-conductor cables carried across the upper arch bridge over the Niagara Gorge. The

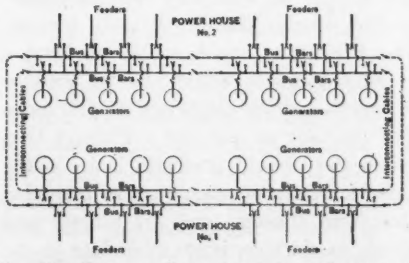


FIG. 10.—SHOWING INTERCONNECTION BETWEEN AMERICAN POWER-HOUSES.

paralleling will be done through step-down Scott connected transformers, as shown.

The switchboard and auxiliaries have not yet been decided upon for this power-house. It is not expected that it will be in operation for a year and eighteen months.

CONCERNING UNIFORMITY IN THE ELECTRICAL ENGINEERING COURSES IN THE UNITED STATES.*

BY SAMUEL SHELDON.

Technical schools and other higher educational institutions, considered as business corporations, are of necessity conducted in a unique manner. Like ordinary business concerns they are sellers of goods, namely, knowledge and educational wares, the students being the customers and paying in money, in time, or in both. The educational institution is in the peculiar position of being able to dictate things which the customers must purchase, and the customers, furthermore, are not in a position to determine the quality and genuineness of the goods de-

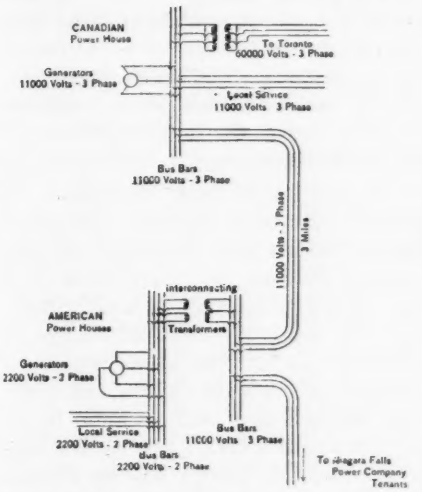

CANADIAN Power House
To Toronto 60000 Volts - 3 Phase
Generators 11000 Volts - 3 Phase
Local Service 11000 Volts 3 Phase
Bus Bars 11000 Volts - 3 Phase
11000 Volts - 3 Phase 3 Miles
Interconnecting Transformers
AMERICAN Power Houses
Generators 2200 Volts - 2 Phase
Local Service 2200 Volts - 2 Phase
Bus Bars 2200 Volts - 2 Phase
Bus Bars 11000 Volts 3 Phase
To Niagara Falls Power Company Tenants

FIG. 11.—METHOD OF INTERCONNECTING AMERICAN AND CANADIAN POWER SYSTEMS.

livered. The condition is modified somewhat by extensive use of the elective system. Because of this condition of affairs, it is of great importance that the professors, the directors, or those who are responsible for the curricula should be well-informed and broad-minded men, be possessed of good judgment and be free from personal motives or bias. The selection of the curricula of the technical courses in our country has unquestionably been influenced by competition in the form of friendly rivalry and by the information given in the papers, the discussions and the personal intercourse of the various professional societies, especially of the Society for the Promotion of Engineering Education.

The determination of a curriculum does not, however, lie wholly in the hands of the officers of the educational institutions. The history of our technical schools

* A paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers, Great Barrington, Mass., June 18 to 21, 1902.

from the foundation of the first one at Troy in 1824 to the present, with its problem of ever-increasing numbers in the laboratory, shows an influence on the part of the student body. This body has distinctly utilitarian purposes. The average student attends a technical school in order to get that which will enable him to earn a living. He desires a better quality of living than he could hope to get otherwise, and he wishes to get it as soon as possible. Such haste may not be for his good, but the mental attitude exists and its existence must be recognized. Probably every instructor has conversed with undergraduates who wished to discontinue their studies and take up, to their minds, lucrative positions, which had suddenly become available. A lack of recognition, on the part of classical colleges, of this impatience of the average student, may account for their apparent conservatism in the past toward technical instruction. At any rate, to its recognition is due, to no small extent, the rapid growth of the technical institutions.

A course in electrical engineering, to meet the desires of its patrons, should be laid out with a view to securing the best possible positions for its graduates. The student body is made up of some brilliant students, some dull ones, and many of medium ability. The course should be adapted to the wants of the last class. The brilliant man will lead his fellow student and will always look out for himself. The dull student will lag behind, but will be much benefited by the struggle.

The average electrical student takes a subordinate position with people engaged in the construction, the sale, the erection or the operation of electrical machinery. The initial rapidity of his advancement depends upon his technical education and could be made a maximum by a thorough understanding between the employer and the educator. His ultimate position seems to be dependent almost entirely upon himself and very little directly upon any special feature in his educational training. Enquiry of employers reveals the fact that there is considerable dissatisfaction with graduates, irrespective of whence they come; that employers prefer to do their own special training and to supply the graduate with his special facts, and that employers consider that the average graduate lacks something, and this something is variously and often vaguely defined as "initiative of thought and action," "breadth of training," "breadth of thought," "training in fundamental principles," "horse-sense," etc.

By reference to the catalogues of a large number of institutions and to Caldwell's admirable comparative table of electrical engineering courses* the following table has been made, which shows the maximum, the minimum and the average time devoted to various subjects in various institutions. The time unit is one hour per week per academic year. This equals about thirty-six actual hours of lecture, of recitation or of quiz, or seventy-two actual hours in the drawing-room, the laboratory or the shop.

TIME DEVOTED TO SUBJECTS.

Subject.	Time in Any One Institution.		Average Time in All Institutions.
	Minimum.	Maximum.	
Mathematics	5	11	9 2
Drawing	3	10	6.2
Physics and Chemistry	7	25	14.0
English	0	11.3	4.5
French and German	0	10	4.9
Shopwork	0	21	7 5
Electrical Engineering	9.5	23 8	16 5
Other Engineering	7.7	23.2	15.8
Thesis and Elective	0	7.1	0.3

There is considerable uniformity of requirements in mathematics, in physics and in chemistry. Apparent differences of time in the above table are compensated by differences of entrance requirements. The time spent on other subjects varies greatly in different institutions. As an instance, electrical engineering students at Cornell spend ten times as much time on shopwork as those in the Massachusetts Institute of Technology. Such differences in the curricula of institutions of unquestionably high standing suggest prodigality in the expenditure of a student's time and suggest the possibility of obtaining much higher teaching efficiency by the adoption of uniform curricula, uniform not only as to the time to be devoted to the different subjects, but also as to the topics to be treated in that time and as to the manner of their treatment. The instruction given in preparatory schools has been very much improved by the standardization of their courses. The time thus saved could be devoted to subjects which would tend to produce the results which employers of graduates now consider as wanting. Perhaps that which the present graduate lacks is the broad-mindedness associated with graduates from classical and art courses and which, as a whole, is considered as an indication of a liberal education.

The results which the liberal educator aims to achieve in his student are the following:

1. To discipline his mind so as to create a power for coordinate thought.

2. To impart to him a knowledge of facts.

3. To develop a power of expression in language or in action.

4. To discipline his emotional sympathy so as to develop an æsthetic taste.

5. To discipline his moral faculty.

The first three are also the aims of a technical education and are accomplished through the study and treatment of special facts lying in a very narrow field. The facts employed by the liberal educator are drawn from the whole domain of human knowledge and are purposely chosen so as to give the student a superficial and general survey of human achievement. A knowledge is imparted of man's relations with the material universe by facts drawn from the natural sciences; with his thinking self or soul by a study of psychology, of logic and mathematics; with his fellow man of the present, from a study of ethics, of economics, of politics and of sociology; with his fellow man of the past from a study of history; with the universe as a whole from a study of philosophy, and with God from a study of religious ideals and problems.

This curriculum has a twofold purpose, first, to assist the student in choosing a calling which will be congenial and suited to his abilities, and secondly to develop roundly all his faculties, so that he may properly use his senses for pleasure, his intellect for truth, his emotions and æsthetic nature for beauty and his will for right and duty.

The average graduate from a liberal course possesses a breadth of culture which is easily distinguished as being in excess of that possessed by the average technical graduate. The two courses have so many immediate purposes in common that this difference might be largely eradicated by a single, carefully planned course of lectures.

It is objected that a uniformity of curriculum leaves no opportunity for the exercise of the individuality of the professor. A man who is strong in one branch, it is urged, should devote more time to that branch than to others. It seems as though the place for individuality were in the university, and, if exercised in the technical institutions or departments, it should be combined with special advantages of material equipment in the same branch or with special conditions due to the location of the institution and its environment. The legitimate ultimate purposes of a technical institution are so utilitarian and different from those of the liberal institutions that the extensive use of electives on the part of professors, which is so admirably adapted to ordinary college requirements, is detrimental to the best interests of the technical student and is wasteful of his time.

* Proc. Soc. Prom. Eng. Education, vii, p. 128.

TRIBUTES TO MR. CHILD.

The ELECTRICAL REVIEW has received a number of kindly letters deploring the death of Mr. Charles T. Child, for several years technical editor of this journal. A few extracts from the first ones received are presented below:

"I desire to express to you my sincere sympathy at the death of Mr. Child, and feel with you that he is a distinct loss to our profession." GEORGE F. SEVER.

"I did not learn until yesterday of Mr. Child's death, and I can well realize your feeling of loss. I have been impressed with his ability, both through personal contact and through reading his articles in the ELECTRICAL REVIEW."

CHARLES BLIZARD.

"I am greatly shocked at the death of my very agreeable friend, Mr. Child. He was an extremely well-balanced man, and I always found him helpful."

JAS. C. BAYLES.

"I was stunned by reading this morning of the death of Mr. Child, and hasten to extend to you my sincere sympathy in the loss of so able a coworker."

JOSEPH WETZLER.

"I was greatly shocked to learn of the death of Mr. Child, whom I knew very well and had grown to admire for his genial personality and his unflagging efforts so well crowned with success."

ROBERT T. LOZIER.

"I am deeply pained to learn of the death of Mr. Child. I sincerely regret his taking away, and am glad to remember that I took occasion more than once to tell him personally that, as a reader, I had noted and appreciated his good work on the ELECTRICAL REVIEW. But I might as well have told him the same thing each time I perused your journal."

WILLIAM MAVER, JR.

"I was greatly pained and shocked to hear by your very kind letter of the death of my good friend, Mr. Child. I had known him since we were students together in Baltimore. He has always been the same cheery, genial comrade that he was then. He was a man of unusually quick intellect, and was rapidly making a strong mark for himself in the profession. When he went to the ELECTRICAL REVIEW I felt that he had settled into his natural bearings, and the work he was doing was a great credit both to you and to himself." LOUIS BELL.

"As a friend of the late Mr. Child, I desire to convey to you my warm and sincere sympathy for the loss you have suffered in his death. Charles Tripler Child was by birth, instinct and principle, a gentleman gifted with a broad and polished intellectuality which won alike the regard and esteem of his contemporaries.

"A warm-hearted, big-souled man has passed away and left a gap that his friends can scarcely hope ever to see filled.

"The catholicity of his attainments as a musician, a linguist, a scientist, a practical engineer and a writer—in all of which he excelled—brought him in contact with a diversity of interests and people, and to extend his acquaintanceship was to increase the number of his friends who held for him esteem and affection. We miss him sadly, and there are many of us. *In pace requiescat.*"

LAMAR LYNDON.

The Death of Mr. Child.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I have just learned with the deepest regret of the death of Charles T. Child, technical editor of the ELECTRICAL REVIEW. Having enjoyed with him an intimate personal and professional friendship, covering the whole period of his connection with the ELECTRICAL REVIEW, and always having the greatest admiration for his unusual abilities and exceptional talents, I feel impelled to ask the courtesy of your valuable space in which to pay a final tribute to my friend.

He had the unusual educational advantages of modern days, topped off with a course in advanced electrical engineering under Dr. Louis Duncan at Johns Hopkins University. As a climax, opportunities of a practical character were thrown in his way, of all of which he availed himself, to try out his theoretical knowledge. He took full advantage of all these chances, as his application for membership in the American Institute of Electrical Engineers well shows.

Child also possessed a marvelous gift of expression, both oral and written, which has been of great assistance and real help to many. Numerous editorials of his in the ELECTRICAL REVIEW have not only elucidated clearly technical questions in dispute, but have pointed the way toward possible industrial advancement. In all his editorial work he addressed an appreciative audience, as I well know, and an audience that listened and learned with the greatest respect.

To my mind, Child had just entered upon his career. He might have been a great technical writer or one of our foremost electrical engineers or one of a few excellent instructors in electrical science.

I but voice the heartfelt sentiments of his many friends when I say that he will be missed. STEPHEN L. COLES.

New York, June 23.

A New Type of Coherer.

A coherer consisting of a steel tripod with slightly oxidized feet, standing on a plate of polished steel, is described by Mr. E. Branly. The oxidation remains in the same state for months, and is carried out at a fixed temperature. The receiving circuit contains this tripod coherer and operates a Claude relay, which brings the accumulator circuit into action. The Morse connections are so arranged that after the signal has been recorded, the recorder, in returning to its normal position, communicates a slight shock to the tripod, which decoheres it and makes it ready to receive the next signal, the tapping device used by Marconi thus being rendered superfluous. It is possible to greatly increase the speed of transmission owing to the feebleness of the shock received. The coherer is shielded from the influence of the spark of its own transmitter by the attraction of an auxiliary electromagnet which serves to lift the tripod very slightly off the steel plate while signals are being sent out.

Aluminum Rectifiers.

Herr E. Konig has made a detailed study of the behavior of aluminum rectifiers. He finds that Graetz's contention that an aluminum-alum lead cell does not transmit a current at a voltage below twenty-two if the aluminum is the anode is partly erroneous. He states that the aluminum cell behaves like a condenser mounted in parallel with a high resistance. Using four cells for the conversion of the alternating current into a pulsating continuous current, he finds that the maximum efficiency increases up to a point with an external resistance of one-half of an ohm with increasing voltage. In the alternating-current circuit there is a phase difference between current and voltage which is greater at zero load than on the continuous-current circuit, and decreases when the load on the latter is increased. He also observes that all cells will show a growth of cylindrical rods of alumina after prolonged use, and this he finds will limit their life.

Charlestown Power Station of the Boston Elevated Railway.

Since the introduction of electricity as a motive power, Boston, in common with other large cities, has experienced a marvelous growth in street railway traffic, and suburban Boston can now be reached from the heart of the city in a comparatively short time. In 1897 traffic became so congested that a subway was constructed, which removed in some degree the cars from the streets in the business portion of the city. The elevated road recently put in operation has further relieved congestion and has added an element of speed hitherto unknown to Boston. It is now possible to go from Dudley street, Roxbury, to Sullivan Square, Charlestown, in twenty minutes, a distance requiring an hour's time by surface cars.

The surface and elevated lines, included under the corporate management of the Boston Elevated Railway, are furnished motive power from eight power stations, *viz.*, the Central, Harvard, Lincoln, Dorchester, Allston, Charlestown, East Cambridge and East Boston stations. These stations, as will be seen, are quite widely distributed, although all are operated in parallel except the East Boston station.

Especial interest centres at present in the Charlestown station, where the first of two large power units recently installed is shortly to be put in operation. In order to accommodate this unit an addition to the original power-house was necessary and great credit is due the Boston Elevated Railway Company for the general appearance of the completed design and the harmonious blending of two radically different types of architecture. Upon entering the station one can not fail to be impressed with the massive appearance of the new Westinghouse vertical engine as compared with the two horizontal units previously installed, and yet so well has the idea of proper proportion been carried out in the building that nothing seems incongruous or out of place.

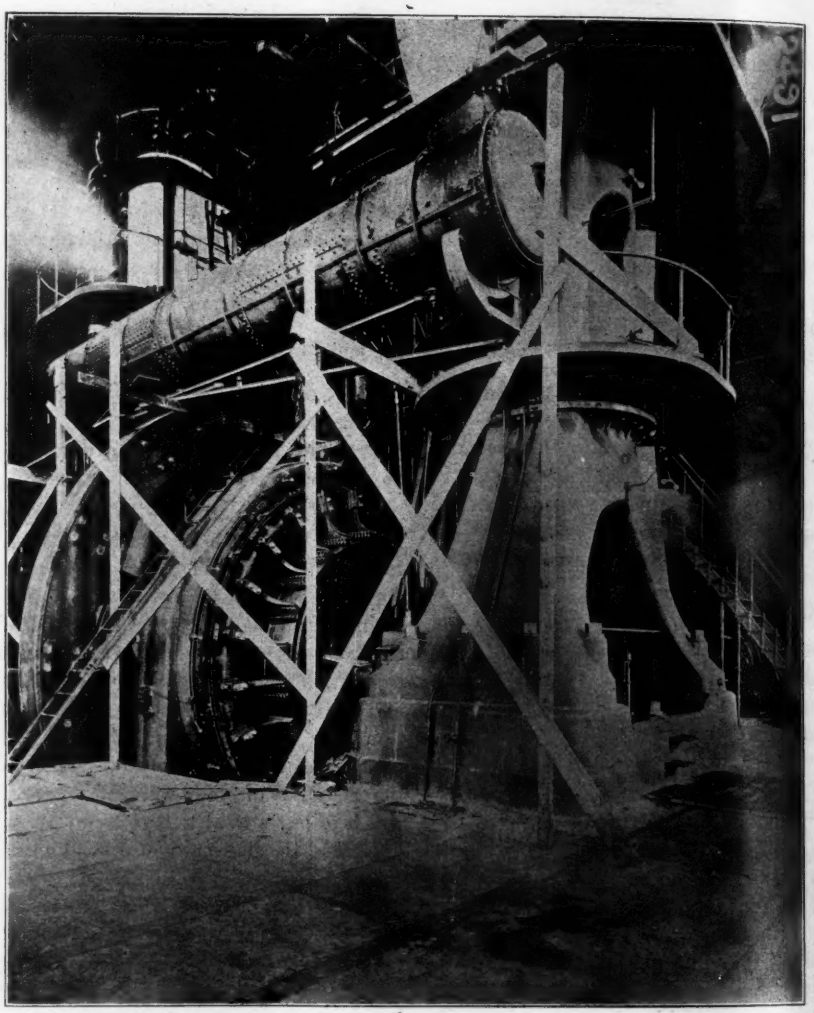
The Charlestown station is located near the Sullivan Square terminal of the Boston Elevated Railway, at a point where water sufficient for condensing purposes can easily be obtained. The equipment of the old station consists of three 500-horse-power boilers of the Babcock & Wilcox type, and two horizontal cross-compound Allis engines rated at 1,000 horse-power each. These engines are direct-connected to multipolar generators of 800 kilowatts capacity.

In order to take care of the largely increased demands of the public service it was found necessary to enlarge the power equipment at Charlestown, and it was determined to install an engine of sufficient size and stability to meet at all times the severe demands of high-class service under the existing conditions. A Westinghouse vertical cross-compound engine was chosen as the best type obtainable for this work, the order being placed through the Boston office of Westinghouse, Church, Kerr & Company. This engine has two cylinders, 44 and 87 inches in diameter with 60-inch stroke, and runs at 75 revolutions per minute. It is given a nominal rating of 4,500 horse-power, using steam at 160 pounds initial pressure, with a vacuum of 26 inches, and has an ultimate capacity somewhat exceeding 7,000 horse-power.

The high-pressure cylinder is fitted with poppet valves for use with superheated steam and the low-pressure cylinder with a Corliss valve gear of Westinghouse design. The cast-steel flywheel is 28 feet in diameter with 26-inch face, and weighs 150,000 pounds. The shaft is of hydraulically forged steel, 37 inches in diameter, with an 18-inch hole in the centre. The total weight of the complete engine is, approximately, 1,125,000 pounds.

The armature of the direct-current generator is carried on the main shaft between the high and low-pressure cylinders. This is one of the four largest direct-current railway generators in New England. It is a 24-pole machine of 2,700 kilowatts capacity. The commutator and armature are twelve and fifteen feet in diameter, respectively, and the total weight of the generator is about 338,000 pounds.

An interesting feature of the switchboard installation, which was also designed by this company, is to be found in connection with the circuit-breakers, which can be thrown out from any portion of the building by means of electric buttons.

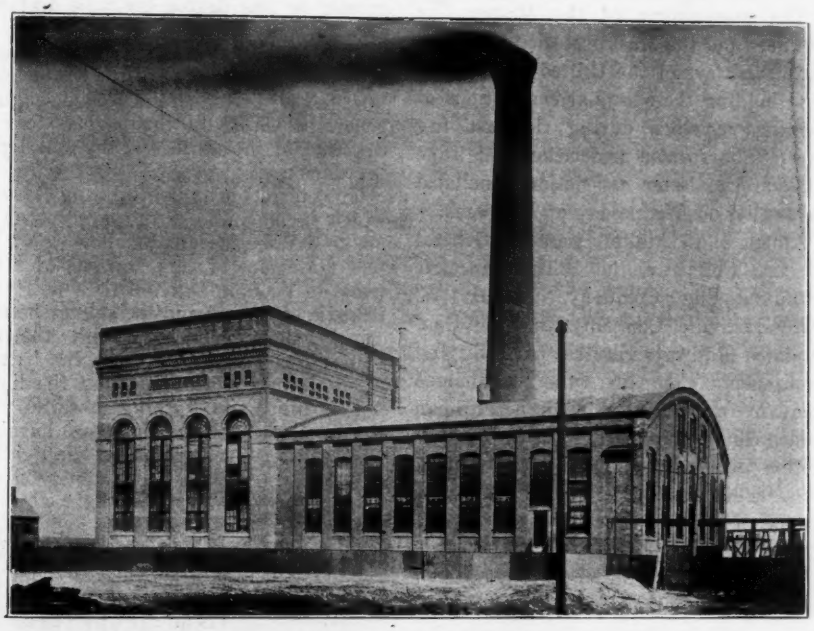


7 000-Horse-Power, Vertical Cross-Compound, Westinghouse-Corliss Engine at Charlestown Power-House of Boston Elevated Railway Company.

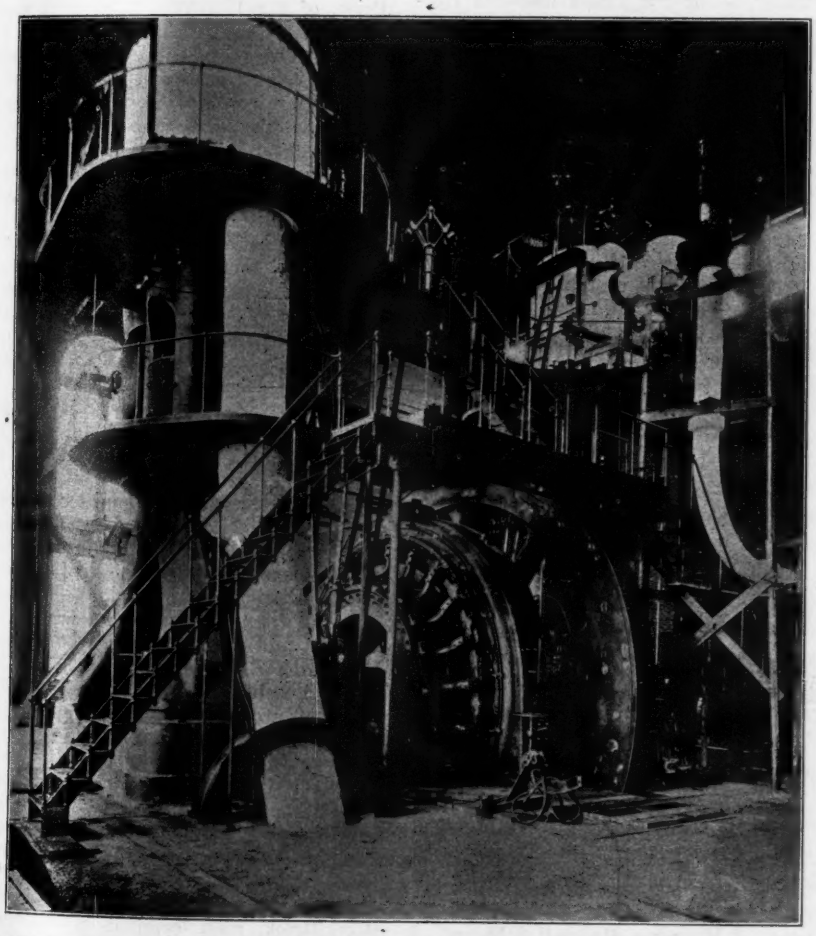
The condensing system includes two Allis condensers for the small engines built by the Allis company, and a Bulkley jet condenser for use with the Westinghouse engine.

The capacity of the boiler room has been increased by adding four 500-horse-power boilers of the Babcock & Wilcox type, built by the Altman & Taylor Company, of Mansfield, Ohio. Coal is supplied to the power-house direct by rail and loaded from cars into overhead hoppers, although the power-house is located so that coal can be brought by either water or rail. The boilers are equipped with Greene economizers arranged in the usual manner with by-pass flues for leading the gases direct to the stack should occasion require. The method employed for the removal of ashes is of particular interest. The overflow from the condensers and pumps is carried through trenches which pass under the ash-pits of the boilers. The ashes can be dumped at will into these trenches and are carried off with the overflow to flats or meadows which are being filled and enclosed.

While the new boilers were primarily installed for the purpose of furnishing steam to the engine, the scheme of piping has been carefully arranged so that the boilers may supply steam to any engine. Cylinder oil for the entire station is forced by city water pressure from a tank located in the basement.



CHARLESTOWN POWER STATION, BOSTON ELEVATED RAILWAY COMPANY.



7,500-HORSE-POWER, VERTICAL CROSS-COMPOUND, WESTINGHOUSE-CORLISS ENGINE (FRONT) AT CHARLESTOWN STATION OF THE BOSTON ELEVATED RAILWAY COMPANY.

The scheme of electrical distribution and auxiliary equipment has been carefully worked out, the details of this, as well as the general installation of the additional power equipment, has been under the direct supervision of Mr. C. S. Sergeant, vice-president, and Mr. C. F. Baker, superintendent of motive power and machinery for the Boston Elevated Railway Company.

A New Water-Wheel Power Plant.

The Electrical Equipment Company, Chicago, Ill., has been awarded a contract for the complete installation of a 2,500-horse-power electric transmission plant, located on the St. Joe River, at Constantine, Mich. The equipment includes six 400-horse-power and two 60-horse-power water-wheels to operate under a 12-foot head. The main drive will be divided into two sections, with three of the larger wheels geared to each shaft which is direct-connected to a 600-kilowatt revolving field, alternating-current generator. Each of the small wheels will be direct-connected to a 35-kilowatt direct-current generator to furnish exciting current for the alternators. In addition to furnishing power for manufacturing purposes, the commercial and city lighting of Constantine, Three Rivers and White Pigeon will be operated from this plant. Several new industries, including a calcium carbide plant, will be located at Constantine to utilize this power. The plant will be in operation December 1, 1902.

Master Car Builders' Annual Convention at Saratoga Springs.

The associations of the Master Car Builders and the Master Mechanics of the steam railways of the United States have been holding their annual conventions at Saratoga Springs during the last few days. The former association met June 18, and the latter association concluded its session on Wednesday of last week.

Among the exhibitors were the General Electric Company, the Bullock Electric Manufacturing Company, the H. W. Johns-Manville Company and the Consolidated Railway, Electric Lighting and Equipment Company, the last-named company showing the modern Pullman palace car "Columbia," fitted up with its system of electric lighting and ventilation. This was the car in which Prince Henry of Prussia traveled when on his recent visit to the United States.

There was an excellent attendance of delegates, and the various papers and topics were discussed at considerable length. The Grand Union Hotel was the headquarters of the associations.

Mr. L. T. Canfield, master car builder of the Delaware, Lackawanna & Western Railroad, in discussing the topic, "Progress Made and the Present State of the Art in Improved Methods of Car Lighting," made the following statements:

There is no one item in the equipment of a first-class passenger train that is more important than that of light. Accetylene gas gives a very bright light of pure white rays. Cars equipped with it have burners that consume one-half cubic foot of gas per hour, and it gives a light of thirty-five candle-power. The Pintsch gas uses a burner that consumes about two cubic feet of gas per hour and gives a light of twenty-five candle-power. . . .

A more equal distribution of light can be obtained with the electric light than any of the others mentioned. It does not vitiate the air in the least and can be lighted without matches, by the turning of a key or switch. You can light or extinguish the same at will without danger. Entering a tunnel all lights can be turned on from one point in the car, or can be extinguished in the same manner on leaving the tunnel. There is no smoke or disagreeable odor, and when first applied the public took very kindly to it, that is, as long as it worked all right. In cases of wrecks there is no danger from fire, as is the case with all inflammable substances, and in my opinion the makers of electric lights for railroad cars should be encouraged by giving them an opportunity to develop their device.

The principal objections to lighting railway cars with electricity are its cost of installation and the cost of maintenance. There are, as you are aware, several systems of electric car lighting in this country, all of which have to a greater or less degree desirable features, also many undesirable ones.

The three most important commercially are the storage battery, the electric motor driven by a steam engine, generally placed in the baggage car at the head of the train, and the axle lighting device.

The third, or axle, lighting system, which in my mind is the best system in use to-day on account of allowing of the free movement of cars, consists of a dynamo or generator driven by a pulley on the axle of the car and the storage battery working in combination with the dynamo; the dynamo charging the battery when the car is running, and the lights not burning, and working in series with the same when all the lights are burning.

At the present stage of electric lighting in railway service it is absolutely necessary to have an auxiliary light at hand to fall back on. I am sure many of us who have had experience with this light would be perfectly satisfied to do away with it on account of the trouble it has caused—but this is an age of progress and there is no doubt but that there will continually be improvements made in electric car lighting. When it is so perfected that it will not require an expense greatly in excess of that necessary to maintain the gas lamp of to-day, I am sure it will come into general use. One point I wish to call your attention to is the fact that the dynamo should be hung to the bottom of the car where it would receive the benefits of both elliptic and equalizer springs to relieve it of all the shocks possible. Another thing, a long belt is desirable in preference to a short one on account of allowing the dynamo to adjust itself to the lateral motion of the axle; but it is absolutely necessary to have the perfect belt cover so as to increase the life of the belt.

After discussion by Messrs. F. W. Brazier, R. D. Smith, Whyte and others, the subject was referred to a committee for an exhaustive report at the next meeting.

Mr. F. G. Bolles, of the Bullock Electric Manufacturing Company, issued lists of delegates and supply men in attendance at both conventions with numbered buttons given to each delegate. These lists were very complete and valuable. Dr. W. M. Habirshaw, of the India-Rubber and Gutta-Percha Insulating Company, of New York; Mr. E. H. Mullin, of the General Electric Company, and Colonel John T. Dickinson, of the Consolidated Railway, Electric Lighting and Equipment Company; Messrs. Moore and Derby, of Manning, Maxwell & Moore, of New York, and Messrs. Haskell and Dean, of the J. G. Brill Company, of Philadelphia, were among the electrical men in attendance.

A Visit to Saratoga Springs.

Mr. George H. Daniels, general passenger agent of the New York Central & Hudson River Railroad, escorted some sixty newspaper men of New York city and ladies to Saratoga Springs, N. Y., on Saturday, June 21, returning Monday morning of last week. The trip was the occasion of the inauguration of the special Saratoga train between New York and this famous resort. This was the fourth year in which Mr. Daniels has extended this courtesy to the press of the city, and a very fast schedule was easily covered, the train arriving a few moments ahead of time, and making a mile several times in less than a minute.

The citizens of Saratoga Springs assembled in the clubroom of the Grand Union Hotel, and through President Knapp of the village welcomed the Saratoga Limited Club, by which name this organization has come to be known. Mr. Knapp's cordial welcome was responded to by Mr. George H. Daniels, president of the Saratoga Limited Club, in a particularly felicitous and happy address. Then, in accordance with the annual custom, the reports of Secretary Louis Wiley, of the N. Y. *Times,* and Treasurer Chas. W. Price, of the ELECTRICAL REVIEW, were read and received with considerable jocular comment, participated in by a number of the bright newspaper men present. After considerable discussion and some hesitation, the above-named officers were re-elected, and in addition Mr. W. J. Lampton, of the New York *Herald,* was elected poet laureate of the club, and Mr. R. K. Munkittrick, of *Judge,* was elected historian. Various committee reports were made from Hawaii and the Philippine Islands. The occasion was a particularly genial and jolly one and will always be remembered with great pleasure by the observers, even if some of the participants did have a hard time.

The following day at Saratoga Springs passed all too quickly, and was devoted to driving, sightseeing and church-going, as the visitors desired.

On the return trip a committee adopted glowing resolutions expressing appreciation of the delightful entertainment that had been provided, and presented these to Mr. Daniels on the train. The resolution of thanks included Mr. George H. Daniels and staff, among whom were Messrs. E. J. Richards, Frank J. Wolfe, M. C. Roach and C. J. Laing, and Mr. Joel T. Burdick, general passenger agent of the Delaware & Hudson, who came all the way from his fishing club in Texas to attend the meeting, and his staff, and the Pullman Company, and the proprietors of the Grand Union, United States, Adelphia-American and Worden hotels of Saratoga Springs. As fitting to the occasion, both Mr. Lampton and Mr. Munkittrick read original poems just before the train arrived in New York, properly concluding the ceremonies of an occasion that ranks as the most enjoyable in the series of outings enjoyed by the Saratoga Limited Club.

The Plant of the Saratoga Telephone Company.

The Features of a Splendid Independent Exchange in Eastern New York.

PROBABLY more new features that are of vital importance to the durability as well as the efficiency of a telephone system, than has ever been brought out in any system at one time, are embodied in the construction of the parts of the system recently installed at Saratoga, N. Y., by the International Telephone Manufacturing Company, Chicago. While it differs to no great extent in its main working from other like successful systems, there are, however, many improvements in building the detail parts in the most durable and economical manner possible.

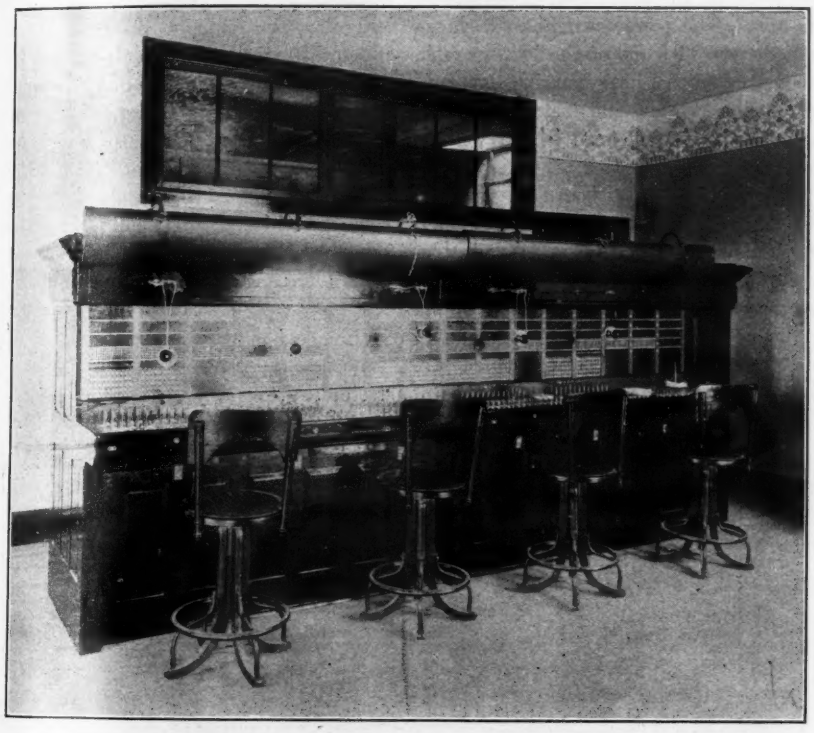


FIG. 1.—THE MAIN SWITCHBOARD AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

The main switchboard, shown in Fig. 1, is a full central-energy lamp signal, multiple board with double supervisory clearing-out lamps. It is built with a frame capacity for 2,400 lines, with a present equipment for 500 subscribers' lines. The frames are built with eight panels to the section, and arranged for three operators' positions. They are constructed of angle iron and well braced to make them strong and rigid.

The sections are so made that when two or more are joined they have the appearance of one solid frame. The front and side of the board, excepting the space for the jacks and signals, are covered with highly polished, dark finish, solid mahogany cabinet work. The back of each section is provided with a dustproof roller curtain, made of heavy canvas and covered with dark red felt.

The plug board is covered with mahogany-stained leather belting. The plug is a two-way or metallic plug. It is of a small, neat construction, but each part is of sufficient strength to make it strong and durable. The polished hard rubber sleeve or handle is mounted so as to avoid the use of a binding screw passing through it. It is put on loose and held in position by a brass collar screwed on from in front, thus leaving the handle free to turn when an operator inserts the plug and avoids twisting and breaking the cord conductors.

The supervisory lamps are placed in a fibre tube, which is provided at its top with a collared setting, holding the opalescent jewel. The glass jewel is protected from impact by the plugs by an arched wire protector fastened to the collar of the setting. This arched wire also serves as a handle, so that the tube with the lamp may be readily removed and replaced at any time from the top of the board. This form of construction leaves the jewel flush with the top of the board, and avoids any accumulation of dust in these parts. The bottom of the lamp-holding tube is slotted to form a guide and leave openings for the lamp-jack contact points.

At the top, in front of each section, is mounted an Acme trough reflector with incandescent lamps. These reflectors are adjusted so that the light may be thrown properly on the front of the board.

The key-shelves are made of five layers of wood, two layers with their grain running crosswise, and the remaining three lengthwise. The shelves are hinged so that they may be raised for inspecting and testing the keys and wiring. The key-shelves are provided with a spring lock for fastening, and are opened with a key. The plugs and double supervisory clearing-out lamps are mounted on a mahogany-stained leather-covered board back of the key-shelves.

The keys are set on the key-shelf with all their contact points toward the front, and the one-key cable which connects all the terminals along the bottom when the shelf is raised for inspecting the working parts.

In the front of the trough of the board under the key-shelf, in each position, is mounted a pair of spring-jacks for operator's receiver connecting-jacks. The answering-jacks, shown in Fig. 2, and the lamp-line signals, in Fig. 3, are placed alternately in strips of ten, with 100 to the position. They are arranged in columns of five strips, or 100 signals in two panels, leaving one vacant panel be-

FIG. 2.—THE ANSWERING-JACK AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

tween each operator in each section. The multiple-jacks, shown in Fig. 4, are duplicated in every six panels, thus greatly reducing the space necessary for an operator to reach in making a connection. Each 100 multiples, in a panel, are separated by a white holly strip, and are blocked by

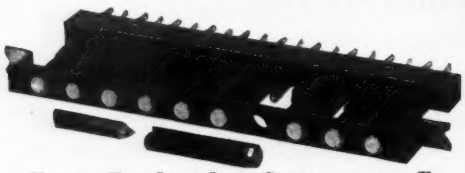


FIG. 3.—THE LAMP-LINE SIGNAL AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

a white line in four columns of five jacks to the bank. The banks of jacks and signals are set into the panels and firmly clamped to the iron frame in front by a toggle screw under the stile strip. Any one bank may be readily removed without

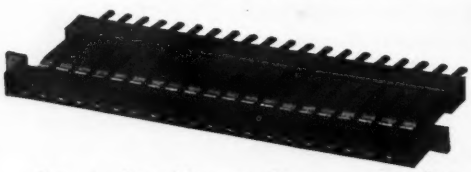


FIG. 4.—THE MULTIPLE-JACKS AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

entirely taking out the binding screw. The stile strips are easily removed and replaced.

The base of the bank of jacks and signals, by which each end is clamped to the iron frame, is of one piece of one-eighth-inch sheet brass, properly formed and extending through the entire front piece of the strip. In the jacks this bar base is provided with holes of sufficient size to receive a hard rubber bushing, with its inner diameter of the same size as the holes in the front and back hard rubber strip through which are placed the jack ferrules. The ferrules are screwed into the bottom connecting-spring, firmly holding the springs and clamping the three parts of the front piece.

The transmitters are mounted on a nickel-plated brass octagon-shaped adjustable arm, provided in front with nickel-plated cord pulleys set in oxidized hangings. The arm passes through an oxidized plate, which plate also forms an escutcheon on each side of the transmitter cords. The arm is guided and held in proper position by an angle arm fastened in the rear of the board.

Each operator's position is provided with three pilot lamps mounted in the mahogany-stained leather-covered panel back of the plug cord. One lamp is to indicate when a call is received, one when a disconnect signal is given and one when an operator rings a subscriber.

All line relays, cord relays and operator's set relays are mounted on the relay rack. In the back of the switchboard no relays, condensers nor coils of any kind can be seen. All like apparatus is placed together at all times.

Fig. 5 shows the complete power plant for the exchange. The battery plant consists of a set of chloride accumulators, with cells of lead-lined wooden tanks. The battery rack is constructed of heavy angle and channel iron, well braced to make it strong and rigid. The batteries are set on shelves of heavy slate slabs supported on the angle iron cross-bars of the rack. The power switchboard, shown immediately in front of the battery rack, is constructed of a heavy marble slab, containing the switches and instruments, and mounted on a stand built of heavy angle iron, all suitably braced.

At the top of the board is mounted two Weston ammeters and one voltmeter. Immediately below the reading instruments is mounted a Western Electric voltmeter switch. In this switch the contact points of opposite polarity are mounted on separate slabs of slate which are fastened on the back of the switchboard. The switch is controlled from the face of the board by a hand-wheel and index plate. This switch gives a positive knife-switch connection, and does not depend on the uncertain pressure of small springs for the contacts.

On the centre of the board are mounted the necessary knife-switches for controlling the entire system.

At the bottom of the power-board are mounted the bus-bars and D. & W. lightning arresters. Immediately above the bus-bars, in the centre, are mounted the rheostats, which are provided on the face of the board with a small hand-wheel and dial plate similar to the voltmeter switch.

All metal parts on the face of the power-board are copper-plated and highly polished.

The power equipment consists of a two-horse-power Wagner motor, directly connected to a two-horse-power Roth charging dynamo for the charging set. For the ringing set is furnished one Roth combination generator and a one-half-horse-power Wagner motor. The combination generator may be operated from the motor or from the storage battery set.

The power machine tables are constructed of heavy angle and channel iron, strongly braced, on which is mounted a heavy wood frame supporting the base of the machines on heavy solid rubber balls.

Fig. 6 shows the combination main and intermediate rack with heat-coil protectors.

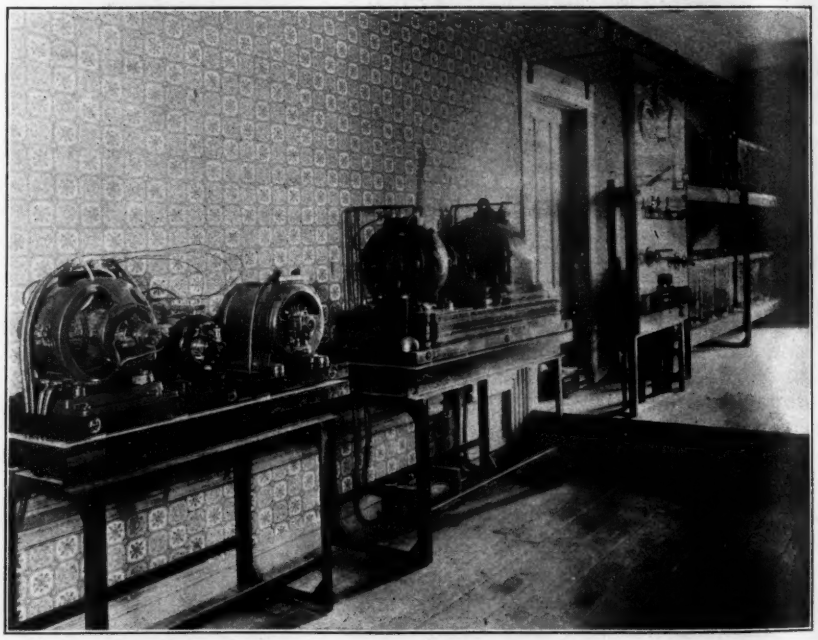


FIG. 5.—COMPLETE POWER PLANT, SHOWING GENERATOR, STORAGE BATTERY AND POWER SWITCHBOARD AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

The desk telephone, as shown in Fig. 7, is constructed with all of its metal parts of heavily nickel-plated, highly polished brass. The switch is mounted in the head

of the pedestal, with all of its contact springs for both sides of the circuits, mounted in hard rubber, perfectly insulating the circuit from the pedestal and hook, and avoiding the use of any of the exposed metal parts for any part of the circuit at any time. The contact springs are of the best German silver and are provided with platinum contacts. The springs and contacts are so arranged that they form a positive sliding connection at all times. The hook-restoring spring is of heavy German silver sheet, and is formed

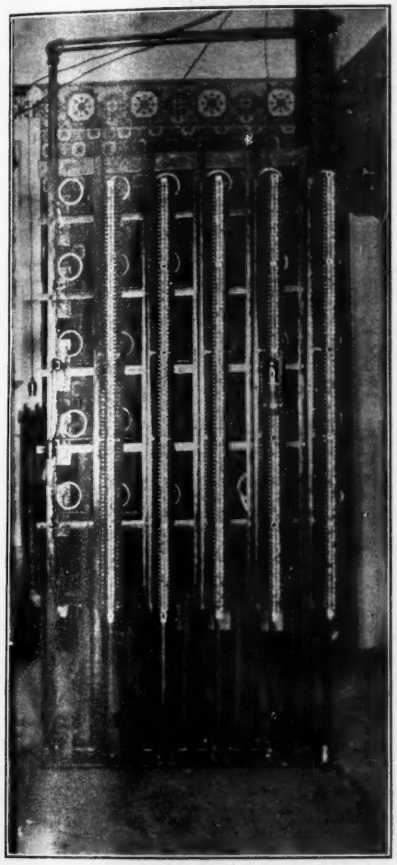


FIG. 6.—COMBINATION MAIN AND INTERMEDIATE RACK AND HEAT-COIL PROTECTORS, AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

to pass around the pedestal on two sides. This construction gives a double spring and furnishes a restorer of three inches in length, making a very live and durable switch, and avoiding the use of a small spiral spring under the switch-hook. The switch springs and the restoring springs are covered with a brass tube-cap to completely conceal the working parts, together with all connecting cords and wires.

The pedestal is provided with an adjustable head for the transmitter, so it may be raised up and down. This adjustable head is provided with a concealed stop for allowing its adjustment the proper distance only.

The transmitter cords taken directly from the front and back electrodes pass through the head and into the base

FIG. 7.—THE DESK TELEPHONE AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

through the pedestal, and terminate in properly mounted binding-posts.

The induction coil is mounted on a neatly constructed, heavily japanned base.

The cord terminals are supported on a fibre-insulated bar mounted on the induction-coil base.

The wall instruments, shown in Fig. 8, are constructed with the usual back-board with shelf. The induction coil is mounted in the base of the arm. The coil box is provided with a false bottom to which it is hinged and locked. The false bottom is permanently fastened to the back-board and can be conveniently opened for inspecting and testing the working parts.

FIG. 8.—WALL INSTRUMENT AT THE EXCHANGE OF THE SARATOGA TELEPHONE COMPANY, SARATOGA, N. Y.

All wire terminals and connecting wires are mounted in the coil box, fully concealed when the box is closed. On this instrument, as well as on the desk set, there are no exposed metal parts, binding-posts, screws or connecting wires that form any part of the circuit at any time.

The Universal Exposition of 1904 Commemorating the Louisiana Purchase of 1803.

Missourians take just pride in the fact that the chief city of their state has been selected for the exposition commemorating the Louisiana Purchase. The choice of St. Louis can not, however, but meet with the general approval of the country at large, for it embodies in the greatest measure those characteristics of energy and progressive life which have made the West the great factor it is in our commercial progress. Not only this, but other considerations lead to the conclusion that St. Louis is most happily situated for the successful outcome of this exposition. It is the most centrally located of all the large cities of the United States, and by far the most accessible. It is situated about midway between the centre of population and the geographical centre of the nation, and the former is moving year by year in the direction of St. Louis.

In times past all roads led to Rome; today it is scarcely exaggeration to say all roads lead to St. Louis. The city is one of the greatest railroad centres of the United States; twenty-four railroads have direct communication with it, and these, with other connections, bring every state and territory within easy reach of what is rapidly becoming the great distributing point of the continent. The shipments in and out of St. Louis last year exceeded 25,000,000 tons, and the indications are that this enormous total will be put into the shade by the figures for 1902. Upward of 225,000,000 pieces of outgoing mail were handled in St. Louis last year. Evidences of phenomenal commercial activity could be multiplied indefinitely.

St. Louis does not, however, depend entirely, or even in large measure, upon its unique location and admirable distribution facilities for its high rank among the cities of the country. Its growth in manufacturing has been even more remarkable than in other lines. Twenty years ago the annual output of its factories was returned by the official census as $114,000,000. The census for 1890 showed an increase of 100 per cent. The announcement of the figures for 1900 has not yet been made, but there is every reason to believe it will show that the aggregate annual value of the product of the St. Louis factories is between $350,000,000 and $400,000,000, or at least $1,000,000 per day, without making allowance for one day's rest in seven.

Turning from St. Louis for a moment it is interesting to note a few facts that

bear upon the prosperity of the Louisiana Purchase as a whole. The wealth of its real and personal property at the time of the census of 1890 was, in round numbers, a little over $13,000,000,000 or 866 times the purchase price paid, which was $12,000,000 in cash and $3,000,000 in assumed claims, a total of $15,000,000.

Its present wealth in real and personal property will, in the forthcoming census of 1900, doubtless be double that of 1890, or a total of $26,000,000,000, at least it will be if the percentage of increase for the decade 1890-1900 is as great as that during the previous ten years, which was a little over 100 per cent.

In brief, the acquisition which cost but $15,000,000 in 1803 is now worth $26,000,000,000 or $1,733 for $1.

The sale which was made by France to the United States portended more than it is probable any of the statesmen of the infant union realized. Napoleon, however, took an almost prophetic view of the transaction, for he is reported to have said, when his instructions regarding the sale had been carried out, "This accession of territory strengthens forever the power of the United States, and I have just given to England a maritime rival that will sooner or later humble her pride."

The universal exposition of St. Louis prompts us to expect that all former efforts of this character will be surpassed. The people of St. Louis are going ahead with characteristic American enterprise to make it a world-beater, both in the extent and in the magnificence of the exhibition. They have already planned that it shall occupy 1,000 acres of ground, which is nearly 400 more than was occupied by the World's Columbian Exposition at Chicago, and they have more money at their command than had the managers of the Chicago fair. It is presumed, also, that by reason of the added experience that has been gained in such matters the money will be made to produce much more, dollar for dollar, in the way of results than was the case at Chicago.

An amount of money equal to the original purchase price of the Louisiana Purchase Territory is now available for the uses of the exposition. Five million dollars has been raised by popular subscription among the citizens of St. Louis, and a like sum has been appropriated by the city. When to this is added the $5,000,000 appropriated by the national government, a total of $15,000,000 is provided for, the exact amount of the price paid for the Louisiana Purchase of 1803. It is not too much to expect that a grand total of $50,000,000 will have been expended upon the exposition at the time its gates are open to visitors.

The Louisiana Purchase Exposition will expend the $15,000,000 received from Congress, the city of St. Louis and private subscription, and $10,000,000 more additional borrowed on the gate receipts. The states and territories of the country are expected to contribute largely, especially those within the Louisiana Purchase, and $10,000,000 is not too much to credit to the account of their expenditures. If to these amounts are added $10,000,000 in appropriations by foreign governments and $5,000,000 by individual exhibitors, a grand total of $50,000,000 is reached.

No one doubts that the St. Louis world's fair will be a magnificent display, but wholly apart from its merits as an exposition it is likely to render this country an important service. Hitherto, our centennials have, generally speaking, commemorated military or political events. The first Congress met in 1774, our independence was declared in 1776, Yorktown was taken in 1781, the Constitution was adopted in 1787, Washington was inaugurated in 1789, and each of these landmarks was recognized a hundred years later. Undoubtedly this was proper and patriotic, and none of these great chapters in our history should be forgotten. The coming exposition, however, marks the great feature wherein the nineteenth century surpassed the eighteenth. New things began to challenge the old order of war and politics. The vast Louisiana territory was peaceably acquired, not won by force of arms. In 1903-4 the St. Louis world's fair will observe the hundredth anniversary of a peaceful transfer.

We can profitably turn to a more detailed consideration of the plans already formulated by the directors of this great undertaking. The ground plan here presented shows the location of the main buildings to be built in Forest Park. From the level plain in the northern part of the grounds the land rises on a slope of about sixty degrees to an average height of sixty feet in a southerly direction. The main exhibit buildings, the big towers, lagoons, basins, canals and statuary groups will occupy the lower level. The Festival Hall, the Art Gallery and its by-buildings, the architectural *chef-d'oeuvre* of the exposition, and the United States Government Building are to be on the elevated tract.

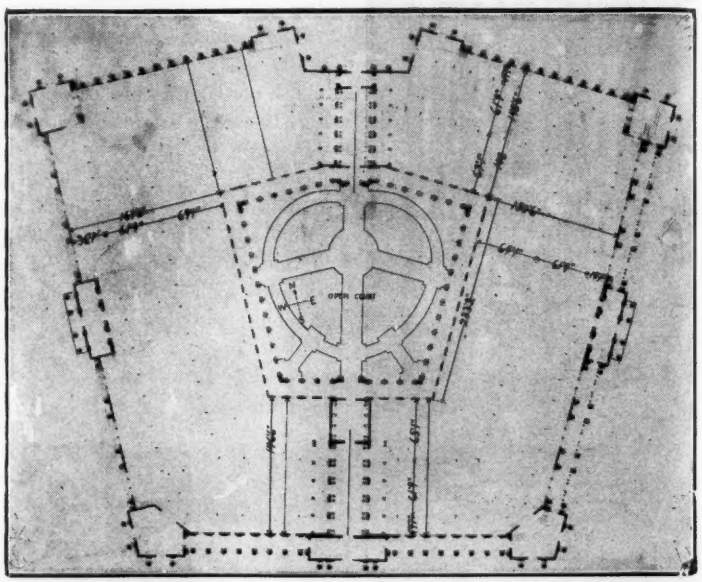


DIAGRAM OF THE ELECTRICITY BUILDING, UNIVERSAL EXPOSITION, COMMEMORATING LOUISIANA PURCHASE.

In the treatment of the intervening slope, the commission of architects had scope for originality. The difference of elevation constituted the chief problem with which they had to contend. They solved it, as shown in the ground plan. Hanging gardens and a series of magnificent cascades fill in this portion of the picture.

The main picture of the exposition is roughly in the shape of a gigantic fan, the ribs of which are the avenues of the exposition. At the apex stands the Art Building. Three great cascades that issue from the sides of the three hills in the form of a crescent are to course down the hillsides and to empty into a grand basin.

(To be continued.)

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Atmospheric Electricity and Lightning Protection.

In an interesting serial article under the above heading, a number of statistics are recorded as to the damage done by lightning. Apart from the ravages of hail and rain this is, on the whole, moderate. The United Kingdom has about one fatal case per million inhabitants annually. In Germany between 50 and 100 are said to be killed, and from 200 to 300 struck. Taking the population at 50,000,000 (49,429,000, according to the census of 1890), we have one or two fatal cases per million annually. In France, Turquan has continued to 1892 the statistics which Arago had carried to 1855. Up to 1872 there were from 30 to 100 fatal cases per year; since then from 100 to 180. The population had not varied much—36,000,000 in 1856, 38,000,000 in 1866 (after the acquisition of Nice and Savoy), 36,000,000 in 1876, 38,340,000 in 1891. Italy, with a population of 30,535,000 in 1892, had 1,625 persons killed by lightning. It is approximated that lightning killed in the United States in the four years, from 1890-1893, 120, 204, 251 and 209 persons respectively, and caused in 1891 and 1892, 457 and 839 fires.—*Engineering* (London), June 13.

M. Hospitalier's Ondograph.

The ondograph is an apparatus which registers direct in ink on a strip of paper, with respect to time, the curves representing periodically and rapidly changing phenomena. It is composed essentially of an asynchronous alternating-current motor, working direct; or, after suitable transformation, by the electrical source of whose periodical variations it is desired to obtain the record; an arrangement of gearing imparting to a revolving commutator a certain angular velocity; an automatic commutator formed of a cylindrical core of insulating material, carrying a brass tube suitably divided, against which three brushes bear; a condenser whose capacity can be varied at will in order to regulate the sensibility of the apparatus, and a measuring apparatus suitable to the phenomena to be registered. For conditions of potential and currents, the registering apparatus is a movable coil placed either horizontally or vertically. For power, the registering apparatus is an ordinary wattmeter. The alternating current traverses the stationary coil, while the movable coil is placed in a circuit periodically closed by a revolving couple on the difference of potential, determining the second factor of the power. This is regulated by the introduction of resistances into the fine wire circuit.—*Electrical Review* (London), June 13.

Magnetostriction of Bismuth.

Since bismuth is the only substance, outside of the strictly magnetic metals, which shows a perceptible elongation under powerful magnetic impression, it seems desirable to study its behavior in this connection under the action of very high fields. In the case of bismuth, an electromagnet can be advantageously employed, for a short rod can be used as well as a long one, since the end effects can be included, and the pole-pieces therefore brought close enough together to produce the powerful field desired. Mr. A. P. Wills, with this idea in mind, carefully selected samples of electrolytically prepared bismuth. These were furnished in the form of cast cylinders somewhat over one centimetre in length and 0.5 centimetre in diameter. One of these was turned until its length was 1.1 centimetres and its diameter 0.52 centimetre. The main experiments were performed with this cylinder. A very powerful electromagnet, belonging to the physics department of the Massachusetts Institute of Technology, was used in the preliminary experiments. The arrangement for measuring any possible change in length of the bismuth cylinder consisted of a system of two levers and a high-power micrometer miscroscope. The pole-pieces of the electromagnet were placed in conjunction with the bismuth cylinder, and the two levers so arranged that they would be perceptible to the slightest variation. This lever had an arm upon which the microscope was focussed. The whole was supported upon a heavy framework of wood and brass. A circular recess was made at about the middle of the heavy brass top bearing of the frame, of such a diameter that it made an easy sliding fit for the cylinder. The bottom of this recess was plane, so that the cylinder rested firmly upon it. A small piece of plane glass was shellacked to the upper face of the cylinder. Each of the levers played on three points of sapphire, highly polished, the levers being of aluminum. One point on the first lever pressed against a glass on the end of the bismuth cylinder, and the other two against a horizontal plate of glass firmly fixed to the supporting bar. These three points were held properly in place by a small spring pulling downward from a point midway between them. The tension on this spring could be varied at pleasure by turning a small windlass to which it was connected. At one end of the first lever there were two sapphire jewels firmly attached with shellack. One of these was a "V" jewel, and the other a "slot" jewel. In these, two of the points of the second lever played, while the third rested on a glass plate firmly fixed to the bar supporting the cylinder. A counterweight, symmetrically placed, served to bring the centre of gravity of the second lever in a vertical line about midway between the points. In the experiments tried, the field was varied, reaching a maximum of 3,200 centimetre-gramme-second units; but neither with the maximum field nor with any of the various intermediary fields could any effect be detected which was not due to one of the following causes: a heat effect, in which time is required to produce it; or an effect due to the action of the magnet on the coils induced in the levers themselves. In this case a sudden jerk was observed when the magnet circuit was made or broken, and then the pointer would return to its zero position immediately. This effect was much more marked when the circuit was broken than when made. These experiments were repeated with a bismuth cylinder of the common market form, and again the negative results only were obtained. It is intended to continue these experiments soon with a much more powerful electromagnet.—*Physical Review* (New York), July.

Joint Electrical Convention.

Summer Meeting of the Northwestern Electrical Association and the Wisconsin Telephone Association, at Waupaca, Wisconsin.

THE ANNUAL summer meeting of the Northwestern Electrical Association began at Amusement Hall, Grand View Hotel, Waupaca, Wednesday, June 25. Mr. Irving P. Lord, the president, presided, and said:

I have the pleasure of greeting you in a dual capacity to-day, first as president of the Northwestern Electrical Association, and second as the only member of this representative body living in the city of Waupaca.

I am glad to see so many familiar faces among those present, and equally glad to see so many new ones.

From appearances and from actual count, this summer convention of the Northwestern Electrical Convention will be the most largely attended of any summer convention that we have ever had. There may be several reasons for this, and I presume the main reason is that business with electrical men has been unusually good during the past two or three years, and perhaps especially so during the year last past. It has, as a rule, been good with central station men, and there are many local plants that to-day are beginning to feel that they have a firm footing, where three or four years ago their future was very uncertain. This should be gratifying to all of us, and no doubt it is. Some one has said that there are three things that all should look forward to, and they are health, wealth and happiness. I feel that most of us are on the road to wealth; by the looks of our faces it can be seen that we are happy, and as far as the third requisite is concerned I will take the chances.

It was hardly intended to make the programme of our summer meeting as laborious as our winter's programme, but rather that we should try to interest each other in matters of equal importance, but of a lighter vein.

I want to offer you, while here, the hospitality of the beautiful Chain o' Lakes, and I am also delegated by the Mayor of the city of Waupaca to tender you the same privilege while you are in town. I invite you to make yourselves at home wherever you are.

These little badges which have been provided for you are a passport to the glad hand of fellowship from every resident of the city of Waupaca. Go wherever you please, do whatever you please, and if there is anything that you want that you don't see, just ask for it.

Now, gentlemen, it is all too true that man proposes and God disposes. We can do many things, but we can not change the weather; we have to take things as they are. I hope that this rain-storm will blow over, and that the social part of our programme can be carried out without any trouble. The country about here is peculiar. It may rain good and hard this forenoon, and by two o'clock in the afternoon the dust is flying—so look out.

The reading of the minutes of the previous winter meeting of the association was, by consent, dispensed with.

G. H. N. Atkin, of Chicago, and the Shelby Electric Company, of Shelby, Ohio, applied for membership and were unanimously elected.

The following paper on "Small Motors" was presented by Mr. S. F. Dibble, of Chicago, and was received with applause:

In the early days of the commercial distribution of current for light and power the people were ignorant of its use and of the accessory devices, and it was essential that the central station in order to create a demand for, and to popularize the use of current should vigorously promote the sale of all devices that required current for their operation; this could be more easily and directly accomplished by selling direct to the consumer than through the comparatively disinterested dealer. Accordingly, practically all central stations became extensive dealers in electrical merchandise.

In those days everything was done in a more or less slipshod and haphazard way; there was no system (that is aside from the "systems" of the various manufacturers, of which there were more than a sufficiency), there was little or no check on the receipt or disbursement of merchandise, and losses were constant from this source, and furthermore the devices were so unsatisfactory that the manager was constantly called on to repair or replace those which he had sold, and a maintenance expense was added which became unbearable. As a very natural result the central station revolted and finally threw up the merchandise business as a good riddance without attempting to discriminate between the devices which it should or should not continue to exploit. This was the opportunity for the cheap manufacturer of which he was quick to avail himself. The dealer had little incentive to handle reliable goods, as there was usually more profit in the cheaper. As a result the circuit became loaded with inefficient, short-lived lamps, motors and other devices of the most remarkable inefficiency. As the business was all on a flat rate the great current-consuming proclivities of these devices quickly became apparent to the central station, but there was no remedy until the advent of the meter. This seemed to be the solution of the problem, and the central station promptly set about installing meters, thereby transferring its burden to the shoulders of the consumer, who now had to pay the penalty of installing devices whose sole reason for being was cheapness. For a time the central station manager regarded this as an entirely satisfactory condition, for if a consumer was so unwise as to install a device that consumed more current than it ought, it meant a larger revenue to the station. Assuredly this was as it should be.

It soon developed, however, that this was not as satisfactory a condition as it had at first appeared. In the first place, the service was unsatisfactory, due to these inferior devices; and second, the cost to the consumer was too great. The more progressive stations soon realized that their position was untenable and set about to remedy it in the only logical way, *viz.*, to regard all current-consuming devices on their circuits as part of their equipment for transforming energy. You all know what was done. The central station began by purchasing good lamps and furnishing them to the consumers at prices so low that the cheap competition was driven out. You know the result also; the service has improved rapidly, the cost has decreased and lighting has now reached a point which a few years ago was not dreamed of. This result has been attained because central stations have realized that the wise policy is to give the consumer for his dollar, not necessarily the most current, but the greatest amount of useful energy consistent with a fair profit on the investment.

Having accomplished such splendid results by safe-guarding the consumer's interests as regards lamps, central stations are now seeking to improve their power service.

Unreliability is perhaps the greatest objection to the poorly designed motor, but low efficiency, while it does not manifest itself so forcibly, nevertheless is doing electrical service a great harm by rendering it impossible for the station to furnish the consumer with the maximum of useful energy. Central stations are not guilty of lack of effort to furnish the consumer with the most for his money as far as the station equipment is concerned, but are they doing all that can be done, and all that eventually must be done, to protect the consumer from the inferior apparatus of his own unwise choosing?

The station managers who were the first to see the wisdom of furnishing their consumers with good lamps now realize the equal importance of protecting their consumers from poorly designed motors, and have adopted substantially the same plan; they have selected some make of motor that possesses sturdy construction and good efficiency and have made arrangements whereby they can furnish it on terms that will appeal to the consumer, and at the same time be profitable to the station.

They have had and will have competition; if it is honest competition selling a good article, so much the better for all con-

cerned; if it is the competition of the unscrupulous dealer or manufacturer it should be and can be crushed. The recommendation of the central station always carries far greater weight with the consumer than the argument of any outsider, for the purchaser can readily see that while the dealer's incentive is the immediate profit on the sale the central station is desirous of having a satisfied customer whose influence will be for, rather than against, electric service, and will therefore naturally recommend a first-class motor.

A very large number of central stations are now vigorously pushing the sale of good motors, and they have found that they now have satisfied consumers whose influence is constantly an aid in securing other consumers and that their power service is therefore increasing, and also that the direct result of personally soliciting motor business has been to reveal possibilities that they were previously unaware of.

It is natural that the large user of power should be eagerly sought, and it is also natural, though not at all logical, that the small user should be neglected. The few large units of power which it is possible for a station to secure are, as a rule, though not always, valuable, but a large number of small units is far more desirable, for the rate is higher, the demand for current is more uniform and there is not the constant threat of establishing an isolated plant in order to secure a lower rate.

This class of consumers can be reached only by direct and persistent effort of the central station; the apparatus that each of those consumers requires does not involve enough profit to interest the dealer, but the profit on the current that will be used makes it well worth the effort of the station to sell the motor. The central station that relies on supply dealers to develop its business will not develop; it is essential that the central station make a personal appeal to every power user no matter how small. Some of you have gone after this class of business systematically and have been surprised at the number of these small users in your cities. Most of them, however, must be sought and furthermore must be sought persistently and systematically.

There is no first step in this direction that can equal intelligent newspaper advertising; a carefully prepared advertisement alluding to one or two classes of current-consuming devices at a time is sure to be a profitable investment. It is a mistake to attempt to cover everything in one advertisement, for then instead of presenting one or two devices forcibly and in a way that will appeal to those who may be interested in them, a list of devices is presented which is of no particular interest to any one. The helpful advertisement is the one that is aimed directly at the man who can use some particular device rather than at the world at large.

Persistent and careful advertising is wise and beneficial, but of itself is insufficient; it must be followed up by vigorous, systematic solicitation; it is in this part of the work that many stations are weak. Business has reached the point now that in order to induce a man to make a change in his method it is necessary to prove conclusively that he will profit by it. The solicitor or station manager who goes out to convert a possible user of power must be thoroughly informed, not only as to rates for current and the general advantages of electric over other forms of energy, but he must be able to tell his customer the size of motor that is required to do certain work and the winding best suited to it; he must be able to suggest the best grouping of machines, and in fact must be able to act as consulting engineer for each individual power user. In order to do this the central station must be in possession of reliable data. Manufacturers are eager to cooperate with central stations in this work, and they are in position to furnish data that may be relied upon. They have engineers whose sole duty is the gathering of data which will enable their selling organizations and their customers to approach the power user with the definite information as to his requirements, which is so essential to a successful argument. There are many central stations that are now being regularly supplied with data on motor applications, which up to three years ago the manufacturers themselves did not possess, and the benefit to the development of electric power service has been very great.

In order to obtain the best results from the solicitation of power business it is of the utmost importance that some one man be entrusted with the work and be held responsible for the development of the power service. Too much stress can not be laid upon this point; the growth of the power service depends upon aggressive and persistent effort, and if no one in particular is held responsible, the effort will not be made. The time of the manager or superintendent is usually very fully occupied by work that must be done immediately, and consequently the task of converting a possible consumer is put off until a more convenient time.

A central station in a town large enough to justify a power circuit can afford to employ a solicitor whose entire time is devoted to the work; if he is intelligent, aggressive and equipped with information and data, the results will abundantly justify the expenditure, and this expenditure need not be large. In every city there are many young men, intelligent and of good address, who are eager for an opportunity to get into the electrical business and who are willing to work for a small salary. A central station manager who has employed solicitors with marked success recently stated that the average cost of soliciting electric service was equivalent to forty days' free service to each new consumer; in other words, the cost of securing each new consumer is approximately thirteen per cent of the first year's income. This manager stated further that he considered that the money which his company expended in this work earned a greater profit than could be obtained through any other channel.

Manufacturers owe their success largely to their aggressive and persistent methods of soliciting business; to be sure they often make life a burden to the station manager, but they get his business. If the station manager will in turn adopt similar vigorous methods with power users he will be abundantly repaid for the effort.

Meter readers can be of great service in this work by keeping the solicitor fully advised as to the requirements of consumers; they have splendid opportunities, and the central station ought to profit by them.

A few motors on hand are of great help to the station in making sales; ability to deliver a motor immediately often secures a customer who would otherwise repair his engine or line shaft and continue in the old way. It is often necessary to install a motor and convince the consumer by actual test that it is cheaper for him to operate an efficient motor than the inefficient motor or line shaft. Of course the station can not carry motors of all sizes in stock, but it can carry a few sizes that will enable it in an emergency to secure a new customer or help out an old one until the proper motor can be obtained. If the station has an office or storeroom where the motors can be connected up for exhibition, the attention of power users is sure to be attracted and sales will be materially increased.

The many progressive central stations which are now vigorously exploiting good motors and thereby rendering it impossible for the inferior motors to handicap them in their efforts to give good service have profited by the policy and are therefore its enthusiastic advocates. Moreover, they have found, somewhat to their surprise, that the hitherto neglected small motor, rather than large motor, is the important factor in the development of their power service.

President—That concludes our literary programme for this morning and in fact for the day. The telephone association people are here, and at the conclusion of our meeting they are to hold theirs.

This afternoon there is a social programme arranged, and it would hardly be fitting to state now just what it would be, for the reason that the weather may cause a change, but everybody will be fully notified of what is to take place. The secretary has arranged a number of contests of different kinds, running, boating, swimming, high jumping, baseball, etc., to be carried out, weather permitting. We are to have a hop at the Amusement Hall to-morrow evening. The band has been engaged for the session here. The orchestra, which is a separate organization, will furnish the music for the dance.

This evening, weather permitting, there will be a boat ride all through the lakes. The boats have been engaged by

the association, and of course everybody with a badge is earnestly invited to enjoy the privilege of the evening's boat ride. We will have the band with us on the boat, and that may help to make it enjoyable.

AFTERNOON SESSION.

The meeting was called to order by the president, Mr. Irving P. Lord, at two o'clock.

The President—We arranged for a very valuable paper from Professor J. W. Schuster, of the electrical engineering department of the University of Wisconsin, but we are sorry to say that Mr. Schuster was unable to be present owing to unforeseen circumstances and though his paper was forwarded by express it has failed to arrive. It is not deemed advisable to delay the meeting, however, on account of the paper, which will appear in its proper place in the published proceedings. There being an inclination to attend the games this afternoon and make better acquaintance, we will dispense with anything in the literary line this afternoon.

Mr. George Cutter presented a resolution of thanks to the people of Waupaca for their pleasant entertainment, to President Irving P. Lord for his untiring and successful efforts to make the meeting of the association pleasant and profitable, and also, and especially, to the ladies of Waupaca for the many courtesies extended.

The resolution was unanimously carried.

President—The convention has received word from Mr. Thomas R. Mercein, secretary of the association, who is now in Europe, stating that he wishes the convention all success.

Adjourned.

The following attendance was registered: C. A. Kulhman, Chicago; W. W. Geisse, Chicago; M. B. Kitt, Minneapolis; J. B. McMullin, Chicago; George C. Bailey, Chicago; A. Meinema, representing M. B. Easton & Company; R. F. Kountz, Neillsville, Wis.; Thomas Ferris, wife and daughter, Milwaukee; F. J. Alderson, New York; H. S. Connor, Shelby, Ohio; R. Valentine, Janesville, Wis.; H. D. Goodwin and wife, Milwaukee, Wis.; Charles Cuno, wife and son, Oconomowoc; Charles Schenneker, Sun Prairie; H. C. Winter, Madison; W. W. Smyth, Jr., Chicago; W. W. Low, Chicago; Thomas Greer, Chicago; L. K. Cushing, Chicago; W. D. Packard, Warren, Ohio; H. J. Way, Chicago; William Smith, Chicago; V. W. Bergenthal, Chicago; L. W. Burch, Madison; C. L. Currie, Jr., Chicago; W. N. Matthews, St. Louis; J. H. Montague, Chicago; C. L. Hibbard, Chicago; S. A. Dinsmore and wife, Chicago; George Cutter and wife, Chicago; A. Smith and wife and sister-in-law, Milwaukee; Charles Messer, Chicago; O. B. Williams, Whitewater, Wis.; A. J. Perkins, Medford, Wis.; W. R. Pinchard and wife, Chicago; George W. Conover and wife, Chicago; James Wolff, Chicago; C. A. Kenworthy, Chicago; Otto E. Osthoff, Chicago; J. Scribner, Chicago; W. H. Colman, Chicago; D. T. Wallace, Chicago; A. W. Bryant, Chicago; C. Knight, Chicago; J. C. Schmidtbauer, Milwaukee; R. B. Abbott, Chicago; W. H. Slingluff, Chicago; J. R. Cravath, Chicago; W. P. Upham, Chicago; J. B. Darragh, Chicago; Harold Almert, Oak Park, Ill.; S. F. Dibble, Chicago; A. L. Hutchinson, Weyauwega, Wis.; H. E. Kepler, Sun Prairie, Wis.; H. G. Slater, Waupaca; E. A. Forbs, Rhinelander; John Rice, Chicago; G. L. Ainsworth, Chicago; John Schnabel, Grand Rapids, Wis.; P. L. Huntley, Grand Rapids; W. F. Collins, Chicago; George Conover, Chicago; Charles Messer, of Dearborn Drug and Chemical Company, Chicago; Charles Ffrench, Chicago, ELECTRICAL REVIEW; ex-Governor W. H. Upham, Marshfield; Frank J. Quinn, Madison; James B. Coal, Minneapolis; Harry Byrne and wife, Milwaukee; M. B. Austin and wife, Chicago; C. W. Welkens, Cleveland; A. O. Kuehmsted, Chicago; J. C. Finch, Chicago; W. D. Kurtz, Appleton; G. B. Foster, Chicago; W. P. Hyland, Fond du Lac; D. M. Fulmer, Florence; H. F. Hamacek, Sturgeon Bay.

WISCONSIN TELEPHONE CONVENTION.

The convention of the Independent Telephone Association of Wisconsin was held at Waupaca on June 25. The meeting was called to order by President R. Valentine at three o'clock. Mr. Valentine said:

The independent telephone movement has experienced a surprisingly rapid growth of late, the increase thus far during this year alone being about twenty per cent. Twenty-nine new companies have been chartered since January 1, 1902, representing a capitalization of $570,640. The Bell telephone people, who for so long a period evinced a most decided hostility to the independent enterprise, have recently adopted a new policy looking toward the conciliation of the independent interests and seeking the accomplishment of this object by permitting independent companies to use the Bell long-distance service. I am glad to say, however, that only four small companies have been short-sighted enough to make a contract with the Bell company. In Milwaukee and Chicago independent franchises are being sought from the common councils of those cities with every prospect of success. These franchises are very important to the independence of this state, as we wish to form a toll-line company that will cover the entire state.

Mr. J. H. Montague, of the Ericsson Telephone Company, spoke of the practicability and efficiency of using the same line for telegraph and telephonic work, and offered to demonstrate the correctness of his position.

Mr. L. W. Burch, of Madison, called the attention of the association to the advisability of adopting some kind of an attractive trade-mark or sign for the use of independent toll lines.

The President—It seems to me that the local companies do not advertise sufficiently and that for that reason it is frequently difficult for a would-be user to locate the telephone.

Mr. Burch—The local companies ought to be more up to date in many respects. A model company is that organized in Orfordville. There are about sixty-seven subscribers, including forty farmers. It raised all the money in advance and has a first-class equipment in every respect.

Mr. A. W. Bryant—Some of the exchanges in Indiana are worthy of imitation. The plan there is to have the farmers buy the telephones, while the company builds the line and charges a rental of $1.25 per mile per annum for its use.

Mr. A. J. Perkins, of Medford, Wis.—We have an automatic telephone exchange in Medford, called the National Automatic Telephone, which will be running two years the coming August. It is patterned after the plant in Odell, Ill. Each subscriber has a switch of his own. The advantages of the system are its secrecy, quickness, reliability and cheapness. The automatic system is all right, although you can not connect it automatically with a toll line.

Mr. Bryant—The National Automatic people at one time had a system for connecting a toll line with their automatic system, which apparently worked all right.

Mr. Burch—I would like to enquire the cost of maintenance of your automatic system.

Mr. Perkins—It costs about two per cent of the income to keep up the line. We think the system is the finest thing for a small town that was ever devised.

The Mount Vernon Independent Telephone Company and the Dane County Rural Telephone Company were admitted to membership in the association.

After some further discussion adjournment was taken until the following day.

The second session of the telephone convention was called to order at 11 A. M., Thursday, June 26.

Mr. H. C. Winter read an able paper on "Toll Rates and Toll Divisions."

Mr. Slater, chairman of the Committee on Toll Rates, reported as follows:

Your committee wishes to recommend the following report for adoption:

Taking each station as a centre, radii are to be obtained by drawing circles of different diameters; that is, take any station that is doing toll business, and you draw a circle from that as a centre, and each circle represents a different rate.

The first circle is to be seven miles in radius, and the rate, 10 cents; 7 to 15 miles, 15 cents; 15 to 24, 20 cents; 24 to 32, 25 cents; 32 to 46, 30 cents; 40 to 48, 35 cents; 48 to 56, 40 cents, etc.

Where a station lies within two miles of a zone it may take the rate of either zone; that is, if the zone is within two miles of the circumference, it is optional with the company whether it charges for the second zone or the first one.

It being optional with the company in the division of combination toll rates, air-line distances shall be the method of measuring toll lines from originating stations to switching and receiving points. Originating exchange stations shall receive twenty-five per cent of the toll rate; originating toll stations, fifteen per cent of the tolls.

In exchange switching or terminating a message shall be allowed a credit of five miles of its toll lines in the division of its tolls.

The system is practically the system recommended in the paper just read.

On motion of Mr. Hutchinson it was voted as follows:

That the present committee, including the absent members, be continued until the next annual meeting, and have its powers enlarged so that it may take up the question of the arrangement of special rates where necessary, and also that the report of the committee just made be adopted.

That the secretary be instructed to have this report as adopted printed, and copies sent to each company of the association, and also each other company in the state, and that the rates adopted in this report go into effect on August 1, and that immediate notice thereof be given by the secretary to every company in the state.

Mr. Hutchinson then presented a paper on the subject of "The Telephone Clearing House." He said in part:

Looking at the business of independent telephone companies from the standpoint of success, their management heretofore has not been all that could be desired, and I am not aware that other states have made much further advancement than has been made by the companies of Wisconsin. I repeat here what I have said on several former occasions, that those engaged in independent telephony are too often men who make the telephone business a side issue in their business affairs, giving it only a small percentage of their attention, and then seeking to apply the same principles which are applied to other business. It is a fact that the dangers and pitfalls which menace the success of the independent telephone companies in the future are not those created by the warring competition of the Bell company and its allies, but rather by those men connected with the independent telephone companies who seek to control their management by rules inapplicable to the telephone business.

I understand that this meeting of the state association will adopt a uniform schedule of rates, which shall be applicable at least between the stations of connecting companies, and which should, as far as possible, be applied by individual companies between stations on its own lines, so that there will be a uniformity of rates throughout the state. As independent telephone companies are not in competition with each other, such an agreement can not be dubbed a trust, nor can the companies be censured for combining to fix rates.

There is but one correct way of checking messages and settling accounts between various companies, and that is the method adopted by banks in settling their balances with each other.

Although a complex undertaking for each company to attempt to check and settle its business with every other company, it is but a simple proposition when done through a central clearing company. The *modus operandi* is as follows: The clearing company furnishes each company at cost with two forms of message slips, one form for messages received, the other form for messages sent. The two forms are exactly alike, except that one is on yellow paper, and the fees are entered under the word "charged;" the other on green paper and fees entered under the word "collected." All entries are to be the same. At the end of each week each station transmits to the clearing company all message slips of all messages passing between it and the station or stations of connecting companies. The clearing company then brings the sending and receiving slips for each message together, and if correct the fees are apportioned to the several companies over whose lines the message has passed and each company credited with its proper amount; if there is a discrepancy in the fees collected and charged, the error is corrected and the station whose slip is wrong is notified to make the correction. The station at the end of the month is then able to send its own company a correct statement of all joint business. At the end of the month the clearing company strikes a balance between the various companies reporting to it, sends each a copy of the balance-sheet and draws a slight draft in favor of the company having a balance due it against the company having a balance owing. No money passes through the clearing company, but its drafts in favor of creditor companies must be honored by debtor companies. It is possible through the simplicity of the clearing office scheme to settle the balances between a dozen companies by a single draft. Not only will each company have its toll business more carefully looked after, but it will also know that it receives every cent that it advances for messenger or other extra services. Not only does the clearing company make the work absolutely simple, but it can do the work at a trifling cost compared with the expense incurred by each company attempting to adjust and settle its own business with that of every other company.

After considerable discussion on this paper, in which sentiment varied, it was moved by Mr. Kepler that a night rate be adopted with no rate less than ten cents and a half rate for all messages over that with an additional amount to make it divisible by five if necessary; time to be from 6 P. M. to 6 A. M. This was carried unanimously.

Resolutions were then passed unanimously: That the thanks of the association be tendered to the Waupaca Electric Railway and Light Company for the many courtesies received by the association, after which the convention adjourned.

Among the gentlemen in attendance were G. C. Bailey, R. B. Abbott and W. H. Slingluff, all with the Roebling's Sons Company, of Chicago; R. Valentine, Janesville, Wis., president Independent Telephone Association, with the Rock County Telephone Company and Rock County Farmers' Telephone Company; Charles Schenneker, Sun Prairie, Wis., president Interurban Telephone Company; H. C. Winter, secretary Independent Telephone Association, and with Dane County Telephone Company and Dane County Rural Telephone Company; L. W. Burch, Madison; J. H. Montague, Chicago; S. A. Dinsmore, Chicago; A. J. Perkins, Medford; G. W. Conover, Chicago; A. W. Bryant, Chicago, American Electric Company; J. C. Schmidtbauer, with Andrae Company, Milwaukee, Wis.; A. L. Hutchinson, Weyauwega, Wis., Interurban Telephone Company; H. E. Kepler, Sun Prairie, Interurban Telephone Company; H. G. Slater, Waupaca, Citizens' Telephone Company; J. F. Smith, Keelyn Telephone Company, Chicago; M. T. Patchin, Weyauwega; J. M. Baer, Appleton.

Congress is about to decide on the construction of an isthmian canal, involving the expenditure of millions of dollars, and it would be well if knowledge in regard to the question were more widely spread. Something in this direction will be accomplished by the article on the Panama route by Professor Burr, of Columbia University, in the last number of *The Popular Science Monthly*. The author was engineer of the government isthmian commission, and has made a thorough study of the different routes. He writes as a man of science, with complete knowledge and without any self-interest or prejudice. It is understood that Professor Burr has in press a book that will review the subject still more fully.

WILLIAM STANLEY.

BY RAY D. LILLIBRIDGE.

Mr. William Stanley, the central figure of the American Institute of Electrical Engineers' Convention, at Great Barrington, is the man whose achievements gave start to the electrical progress in the Berkshires, which has made that section of the country famous the world over as one of the centres of development of things electrical.

In the very town of Great Barrington, where the electrical engineers recently held forth, William Stanley demonstrated to the world the commercial feasibility of the alternating-current system, thus providing the means by which electricity could be served through comparatively small electrical conductors over considerable distances. To-day the great transmission feats of California, of which so much has been heard, where electric power is profitably conveyed over a stupendous distance of 220 miles, are the direct results of Mr. Stanley's successfully solving the problem at Great Barrington in 1885. Practically throughout the entire equipment Stanley apparatus is used on the world's greatest transmission lines. Not only are the stupendous feats made possible by the alternating-current system, but throughout the whole world electric light and power systems are in vogue supplying two-thirds of all current used, which are also the direct evolutions of Mr. Stanley's work.

It was in the spring of 1885 that Mr. Stanley was taken ill and removed from Pittsburg to Great Barrington for his health. When he was able to be about he hired a disused rubber mill located some distance from the centre of the town and engaged several assistants to construct the apparatus necessary to demonstrate the system which he had conceived. This work resulted in the building of the plant known to electrical engineers the world over as the Great Barrington plant by which alternating current at 500 volts pressure was generated and lead to the town proper where transformers were connected and installed for the purpose of lighting part of the business section. The successful operation of this plant was undeniable proof that the means had been found by which electricity could be served over and throughout a large area commercially. It was a year or so prior to Mr. Stanley's building the Great Barrington plant that he made the acquaintance of Mr. George Westinghouse, who was at that time desirous of getting into the electric lighting field. This acquaintance resulted in the formation of a company which has since become the Westinghouse Electric and Manufacturing Company.

In the winter of 1890 and 1891 Mr. Stanley organized a company at Pittsfield, Mass., the Stanley Electric Manufacturing Company, for the purpose of making electric apparatus, and the first work that this company attempted was the production of a new type of transformer which embodied several important improvements over the type then in vogue. At this time there were no alternating-current motors, and as there was a great demand for such motors from the electric light stations of the company, Mr. Stanley, with his associates, Mr. John F. Kelly and Mr. C. C. Chesney, undertook the production of a self-starting motor that would give the alternating-current system the same advantages that were possessed by the continuous-current system when operating continuous-current motors. This they accomplished and the first successful Stanley motors were completed about the early summer of 1892. As the operation of these motors required that the generators which would furnish them with current should provide at least two alternating currents differing in phase, as the introduction of the motors was limited by the lack of necessary generators, the Stanley Electric Manufacturing Company proceeded to enlarge its capital and add to its equipment the necessary appliances for the manufacture of alternating-current multiphase generators. The machine well known to the electrical men as the inductor type was the result of this move. There is now no more efficient piece of electrical apparatus than the Stanley type of electrical generator. In 1894 the Stanley Electric Manufacturing Company installed a multiphase transmission system at Housatonic, Mass., for the purpose of carrying the power developed by waterfall, between Glen Dale and Housatonic, to the Monument Mill Company of that village. This plant operated at 2,000 volts and was probably the first commercial installation of the transmission of electricity and its use as power in this country. This plant was followed by the introduction of electricity by many other plants in various portions of the country and in Canada, where many thousand horse-power were being transmitted by the Stanley apparatus. Among these plants are those already mentioned of California which transmit 60,000 volts. Mr. William Stanley is a native of Brooklyn, N. Y., where he was born December 2, 1858. His electrical work began with his acquaintance with Mr. Hiram (now Sir Hiram) Maxim, which he formed in 1877 when Mr. Maxim was chief electrician of the United States Electric Lighting Company, of New York. Mr. Maxim at that time was one of the foremost inventors in electrical engineering work, and with him Mr. Stanley laid the foundation of his career. After serving a short apprenticeship with Mr. Maxim he was promoted to the position of first assistant, and in that capacity had charge of developing such new work as the company undertook.

When Mr. Maxim left the United States to go to the Paris Exposition, in 1891, Mr. Stanley resigned from the United States Electric Light Company and was engaged as assistant to Mr. Edward Weston, of the Weston Electric Light Company, of Newark, N. J. Later, in 1882, while with the Swann Electric Light Company, of Boston, Mr. Stanley invented and perfected the methods of exhaustion for the incandescent lamp which are now largely used throughout the world, and which helped to make the incandescent lamp the success it is. Prior to the Roebling interests absorbing the Stanley Electric Manufacturing Company, Mr. Stanley organized a company in Great Barrington, the Stanley Instrument Company, for the manufacture of a new and decidedly novel wattmeter. The guidance of this concern's interest is his present vocation, and it may be added that new apparatus of great novelty in electrical engineering is now in course of commercial production at the works of the Stanley Instrument Company in Great Barrington.

Alternating Currents.

A short time ago the writer had a somewhat complex problem in line construction to work out and, with considerable self-complacency and overconfidence, consulted a noted work on polyphase currents for possible light on the matter, he therefore begs leave to submit a few conclusions for the guidance of his fellow workers:

For reactance, for condensance, for inductance, have a care,
The susceptance, the admittance, the reluctance at you stare;
The resistance, the impedance, the conductance will be there,
For the man who fools with alternating currents.

Lag-factor, power-factor, cycles and the like,
Sine waves distorted will be coming down the pike;
Induced electro-motive force an awful blow will strike;
The man who fools with alternating currents.

Hysteresis, interlinking magnetic flux delight,
Capacity or lack of it, you must always keep in sight;
Synchronism, resonance, how they will excite
The man who fools with alternating currents.

Instantaneous values, or values not so quick,
Of currents that are wattless you can always have your pick;
The point of saturation undoubtedly will prick
The man who fools with alternating currents.

Effective intensities, harmonics high or low,
Phase displaced or otherwise, has got to have a show;
A man would never tackle it if he could only know
What it means to fool with alternating currents.

GEO. B. LAUDER.

CONCORD, N. H., June 7.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Electric Lights at the Canadian Convention.

The headquarters of the Canadian Electrical Association during its annual convention, from June 11 to 13, was at the Chateau Frontenac, Quebec. One of the most interesting features during this celebration was the installation of some 4,500 lights for decorative purposes by the National Electric Improvement Company, using its "Elblight" system of cable lighting. The banquet room of the association was profusely decorated with miniature green and white lights, and this feature was so much appreciated that probably about half of the bulbs were taken away by the guests as souvenirs.

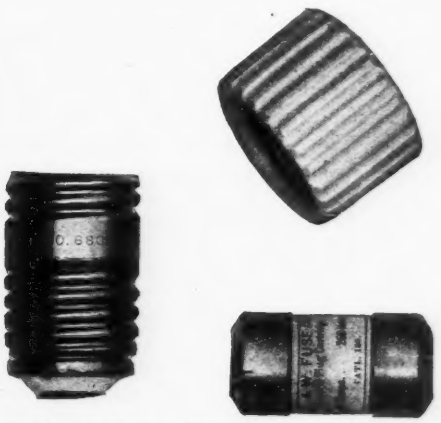
The Dufferin Terrace, one-third of a mile long, was festooned from end to end with "Elblight" cable and 2,000 lamps—blue, white and red, representing the French national colors. In addition to the wreathing and festooning made possible by the cable lighting system of this company, there were a great number of set pieces, which is made practicable by its lighting board system, representing hearts, circles and various other ornamental designs. The entire lot of the "Elblight" material taken to Quebec for this display has been bought by the residents of Quebec, who intend to use it for decorations during the festivities which will be held this summer.

THE INTERIOR DECORATIONS OF THE CHATEAU FRONTENAC, QUEBEC, DURING THE CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION, JUNE 11, 12 AND 13.

The accompanying illustration is a view of some of the interior decorations at the Chateau Frontenac. The engineers, manufacturers and contractors represented at the convention were highly pleased with the effects produced by this system of decorative lighting, and it will no doubt become very popular in Canada as the result of its exploitation in this manner.

A New Plug Fuse.

The D. & W. Fuse Company has recently placed upon the market an improved form of 250-volt plug fuse to fit the standard Edison cutout. This company was among the first to produce a plug fuse which would operate satisfactorily on 250 volts, and which passed the requirements of the National Board of Fire Underwriters. A very large number of these fuses were sold, but the new plug which they are now turning out is considered a decided improvement. The accompanying illustration shows the plug assembled and its several parts, consisting of the casing, porcelain cap and the small cartridge which contains the fuse proper.



NEW 250-VOLT PLUG FUSE FOR EDISON SOCKET, SHOWING CARTRIDGE.

All that is necessary to recharge one of these is to remove the burnt-out cartridge and insert a new one, an operation which requires not more than two minutes at the most. This company supplies cartridges which are all interchangeable in capacities from three to thirty amperes. This little device was recently subjected to most severe trial, being directly short-circuited across a 250-volt circuit within ten feet of the switchboard of a large central station having a capacity of between 4,000 and 5,000 kilowatts on the busses. They repeatedly operated with absolute freedom from flash, noise or discharge of any kind, and later were short-circuited directly across a 440-volt circuit under the same conditions where they operated with perfect success, the only difference being that there was a slight noise at the instant of rupture of the fuse.

Multiple Arc Lighting System.

It has been demonstrated, both in theory and practice, that the alternating-current system is the best adapted for the general distribution of electrical energy, owing to its great flexibility. Various translating devices for transforming it to render it suitable for various commercial purposes have been developed as circumstances arose which made them desirable. The introduction, however, of a satisfactory alternating-current street arc lighting system has been one of the most difficult problems for lighting engineers to solve. The Fort Wayne Electric Works has developed the system described below as the best adapted in most cases to give satisfactory service. It has been installed in numerous places and is giving excellent results. The leading feature of the system is the readiness with which existing incandescent lighting systems may be adapted to include an arc lighting system with a minimum expenditure for line material and equipment. The general plan of the multitude system of enclosed alternating arc street lighting is illustrated in Fig. 1. This diagram shows a complete installation, and illustrates the method of distribution by a three-wire system from which incandescent lights and arc lights may be operated from the same high-potential mains. The particular application here illustrated is that of a 2,000-volt alternating-current incandescent distribution system, having step-down transformers from which the secondary mains are supplied with current at standard incandescent lamp voltages. Diagram No. 2 illustrates the only change in the equipment of the power station rendered necessary by the addition of an arc lighting distribution system. By referring to this it will be noticed that it has been necessary only to install one wire in addition to the incandescent mains, and a single-pole, single-throw switch (A. Fig. 2) connecting this third wire with one side of the incandescent lighting circuit. The arc lamps are operated on small individual constant-current transformers, one transformer for each lamp, connected to the third wire and the opposite side of the incandescent circuit. By this means it is possible to use one side of the existing incandescent lighting circuit as a common wire for the arc lighting and incandescent lighting circuits. This plan can be followed in a great majority of cases. There are, however, a few instances where incandescent mains and arc circuits are widely separated, and it is here found necessary to extend one side of the incandescent mains to accommodate the arc lighting circuit. In general this system can be installed in any locality requiring street lighting, but the particular case where its application can be made most advantageously is in small towns or suburban districts already supplied with an incandescent lighting system. In such cases the demand for light is not usually such as to warrant an outlay of capital sufficient to provide a separate set of arc light mains and the accompanying switchboard and other station equipments. The usefulness and adaptability of the system is not limited to the cases just mentioned, but it may be extended to the full capacity of the station. In this way a much larger generating unit may be installed than is needed for incandescent lighting, thus obtaining the advantage of high-efficiency generator, as well as saving in the original cost of installation.

The "Wood" transformer used with this system is designated as type MA, signifying multiple arc. It is designed to operate on 1,000 or 2,000-volt primary alternating-current circuits and develops practically constant energy in the secondary with wide variations of resistance in the secondary circuit. A short-circuit of the secondary of one of these transformers affects only the one lamp to which it is connected and will not interfere with the operation of any other part of the system. The transformer can be adjusted for various secondary voltages and frequencies. Considerable variation in the primary voltage does not materially affect the value of the secondary current. The primary and secondary coils are wound entirely separate and never come in contact with each other when the various adjustments are made, thus reducing to a minimum the chances of cross-connections between the coils. The "Wood" primary fuse box used in connection with this system may be either double or single-pole, according to the conditions of installation.

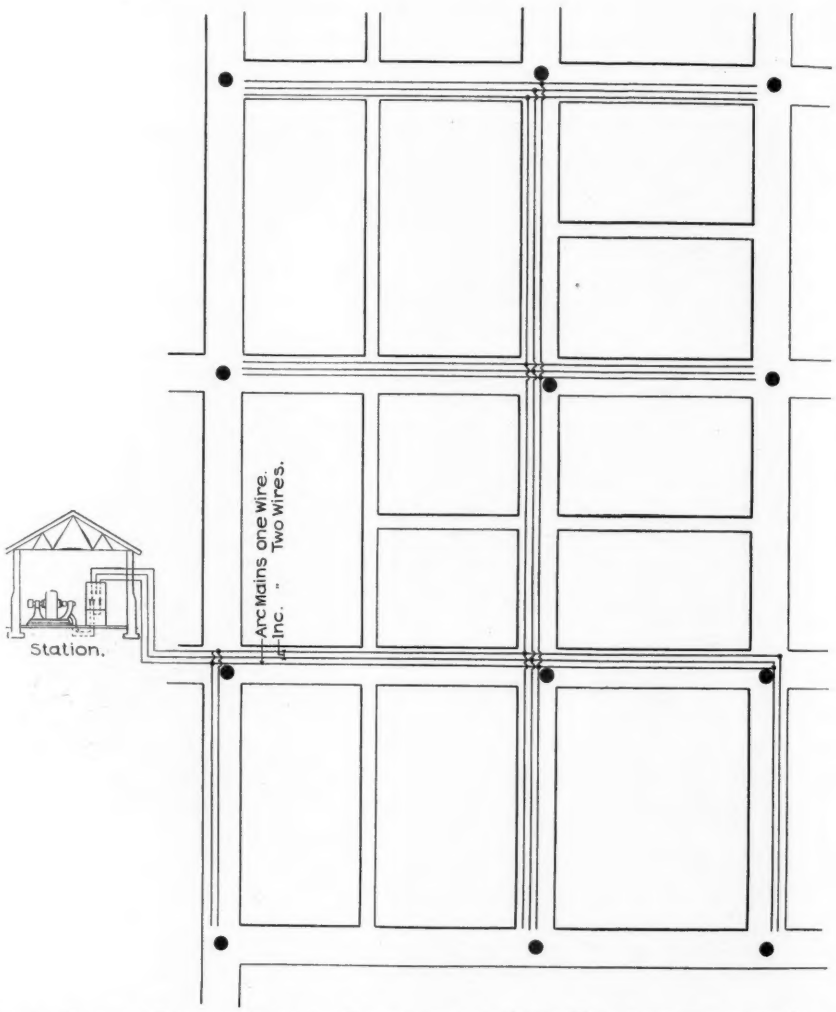


FIG. 1.—DIAGRAM SHOWING METHOD OF DISTRIBUTION BY THREE-WIRE SYSTEM BY WHICH INCANDESCENT LIGHTS AND ARC LIGHTS MAY BE OPERATED FROM THE SAME HIGH-POTENTIAL MAIN.

The "Wood" arc lamp used in connection with this system is the new enclosed form C recently developed by the Fort Wayne Electric Works, and the general appearance resembles the enclosed series arc lamp recently introduced. The interior construction and mechanism is practically the same as in the other lamps of this design, and includes many of the valuable features of simplicity, interchangeability, cool operation and substantial construction. The lamp operates at 6.5 amperes with 75 volts at the arc and consumes 413 watts.

The efficiency of this system is very high and does not vary with the number of lamps in service, but remains constant for all loads. This is an advantage possessed by the multiple system which is lacking in other systems, in which the efficiency diminishes rapidly as the load decreases. The same may be said of the power-factor. It is high and the same with any number of lamps in operation, hence the system does not consume unnecessary generator capacity when operating at light loads. In a constant-current series system the apparent energy is the same for all loads, which means the same consumption of generator whatever the number of lamps in operation, while in the multiple system it varies in direct proportion to the number of lamps in operation. The great flexibility of this system is one of its leading features since it permits the operation of arc lamps of various candle-power on the same circuit simply by the use of properly adjusted type MA transformers. In a series system this can not be done as the line current is maintained at a constant value. In many instances it may be desirable to locate single arc lamps where arc circuits are not installed, particularly where municipalities require additional arc lamps at distant points of suburban districts. In such cases it is only necessary to obtain a single unit, consisting of arc lamp, type MA transformers, and fuse boxes, connecting with the primary distribution mains in the same manner as extensions of the incandescent system are made. In this way the system obtains all the advantages of an incandescent lighting system, and at the same time retains the valuable features of a multiple arc lighting system. Some of the important points claimed for this system are its high efficiency and its extreme simplicity and flexibility.

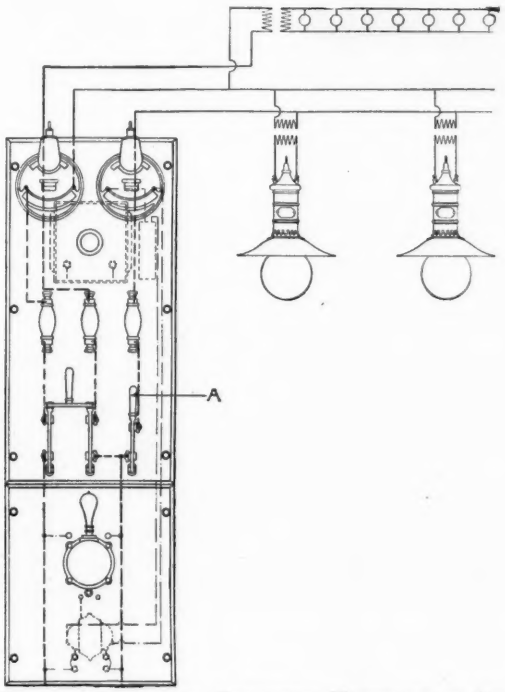


FIG. 2.—DIAGRAM SHOWING CHANGE IN EQUIPMENT NECESSARY BY ADDITION OF AN ARC LIGHTING DISTRIBUTION SYSTEM.

Induction Motors at the Continental Iron Works.

The Continental Iron Works, of Brooklyn, N. Y., the builder of the famous "Monitor," has recently purchased from the Westinghouse Electrical and Manufacturing Company considerable additions to its electrical equipment. The purchase includes a 180-kilowatt, 220-volt, 60-cycle, two-phase alternator, a five-panel switchboard, eleven induction motors of from five to twenty horse-power each, with the accompanying auto-starters. The company some time ago installed alternators of 120 kilowatts and 45 kilowatts each, and of the same characteristics as the above. It also has quite a number of induction motors in use driving corrugating and bending rolls for making Morrison fire boxes, also driving fans, shears, tools in the machine shop, etc. Some of the motors which have recently been purchased are to displace direct-current motors, the original installation at this particular plant having been of direct-current apparatus. Afterward a forty-five-kilowatt alternator was put in to try alternating-current distribution, and subsequently the 120-kilowatt and 180-kilowatt alternators have been purchased. The direct-current motors are rapidly being replaced by alternating-current induction motors, and this is after a thorough and careful investigation of the subject and several years' trial of the induction motors. In fact, when the new 180-kilowatt alternator is installed, the old direct-current generator will be used as an exciter, also furnishing current to one or two small direct-current motors which will be used for awhile until they are worn out.

Honors Richly Deserved.

[*New York Sun.*]

Charles Proteus Steinmetz, the foremost expert in applied electricity of this country, and therefore of the world.—*President Eliot, conferring the degree of A. M.*

Good. Mr. Steinmetz was on the *Sun's* list of the hundred Captains of Industry, whose great place in their respective callings entitled them to be present at the memorable luncheon to Prince Henry of Prussia. The Committee of Invitation thought so too. Mr. Steinmetz's services to the General Electric Company prove him to be what President Eliot describes him. But why, then, make him merely an A. M.?

Electrochemical reactions depend upon the fact that the salts of metals are dissociated when in solution. When potassium chloride is dissolved in water what actually exists in the water is a succession of free atoms of chlorine and potassium with great electrical charges. Similarly when silver or gold cyanide is dissolved in potassium cyanide solution the aloms are free; the weaker the solution the more perfect such free condition. As soon as the atoms of gold or silver lose their charge of electricity (as they do when an electrical current is passed through), gold with its ordinary properties is at once produced and precipitates itself in the solid form.

The Sage Ohmmeter.

It is probably not generally appreciated that this otherwise well-known resistance measuring instrument can be used for making many tests which are not within the range of an ordinary Wheatstone bridge. They are so nearly absolutely non-inductive that it is feasible to use alternating current instead of battery power without introducing any appreciable error, and this of course enables such work as measurement of inductance and capacity and the resistance of electrolytes to be accomplished.

The seven figures of the accompanying diagram show various methods of connection. Fig. 1 shows how an ordinary resistance is connected to the ohmmeter when it is desired to measure its value in ohms. Fig. 2 shows the complete scheme of connections of the ohmmeter. Fig. 3 shows how inductances are compared, A being the unknown inductance and B a coil whose inductance is known. Fig. 4, how the resistance of an electrolyte is measured. It will be noted that this is connected in the same way that an ordinary resistance is attached, but that the alternating current obtained from the secondary of an induction coil is used instead of the direct current ordinarily furnished by the batteries contained in the instrument. Fig. 5 shows how crosses on lines may be determined by the ordinary loop test, and Fig. 6 the location of grounds in a similar way.

In Fig. 7 are shown the connections for measuring capacity, C′ being a standard condenser and C the unknown capacity. In this case, as in Fig. 4, an alternating current is employed in place of the direct current. The length of the scale of the ohmmeter on which the resistances are read off is thirty inches. As the scale of any ordinary portable volt or ammeter is but five inches long, some idea can be had of the fineness of readings obtainable. The instrument itself is illustrated in Fig. 8.

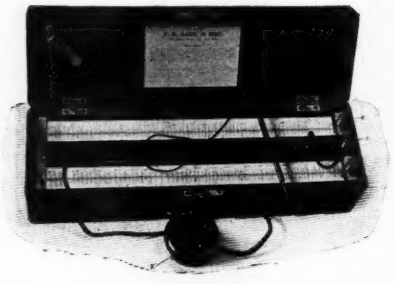
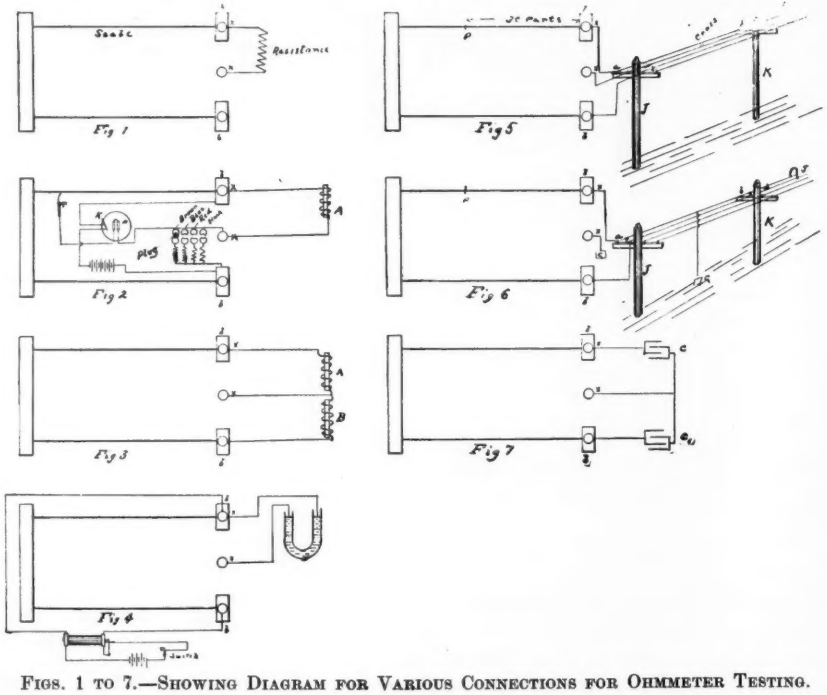


FIG. 8.—THE SAGE OHMMETER.

Machado & Roller, of 203 Broadway, New York, the general selling agents for the Whitney Electrical Instrument Company, have arranged for the exclusive manufacturing and selling rights for these interesting devices.



FIGS. 1 TO 7.—SHOWING DIAGRAM FOR VARIOUS CONNECTIONS FOR OHMMETER TESTING.

A Practical Corner Bit Brace.

The accompanying illustration shows a practical tool for electricians, steamfitters, plumbers, bell-hangers and telephone men. This brace is especially adapted to give service where other means would fail, taking the place of a breast drill and ratchet brace, and being especially useful in corner boring and between beams. The manufacturer, the Du Mont Tool Company, of Buffalo, N. Y., claims that the work done with this tool ensures accuracy and rapidity, being a great saver in time and energy.

The principal feature of the bit brace is the hard steel universal joint. This is made of the best quality of material, and all the other parts are finished in an excellent manner. They are made with an eight-inch and ten-inch sweep.

A NEW CORNER BIT BRACE FOR DIFFICULT BORING.

Car Heating and Lighting Company.

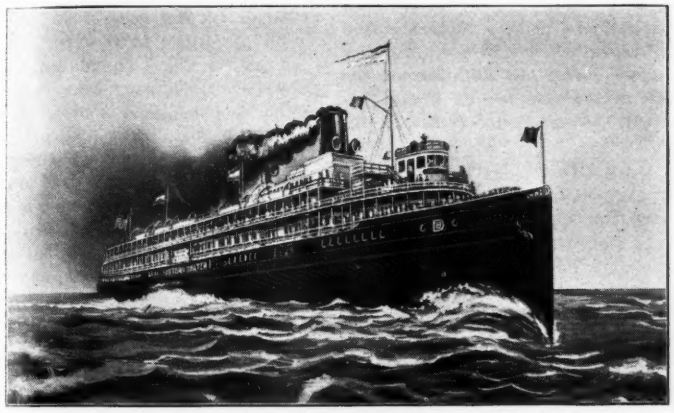
The Gold Car Heating and Lighting Company, which has just been incorporated under the laws of the State of New York, with a capital of $1,000,000, has purchased outright the entire business of the Gold Car Heating Company, of New York, Chicago and London, and also the entire business of the Gold Street Car Heating Company.

It took possession on July 1, 1902, of all the property of both of these companies, and in addition to nearly 100 patents already owned by them, has acquired a number of new and valuable patents covering electrical apparatus.

The business of the Gold companies has increased enormously during the past few years, and now extends all over the world, wherever railway cars are operated by steam or electricity.

Among the large electric heater contracts recently received is one from the Louisville Railway Company for over 300 sets of car heating apparatus, and orders from the Jersey street railways for about 100 equipments, as well as from the Boston & Maine, New York, New Haven & Hartford, Massachusetts electric companies and South Side Elevated Railroad, of Chicago. A contract has recently been closed with the Metropolitan Street Railway, of New York, for electric heating apparatus which will be a departure from anything of this character heretofore undertaken.

In addition to all of the new work now under way, the Gold companies have already equipped nearly 40,000 cars and locomotives on about 500 railroads all over the world, and their apparatus is spoken of in the very highest terms wherever it has been used.



THE STEAMER EASTERN STATES, EQUIPPED THROUGHOUT WITH ELECTRICAL AUXILIARIES.

All of the stockholders of the old companies will be numbered among the stockholders of the new company, the plan having received the unanimous approval and consent of every shareholder in all of the properties purchased. The main office of the new company will be at New York city.

Electrical Steamer Equipment.

During the recent invitation trip by a party of New York publishers and editors, given by the Erie Railroad and the Detroit & Buffalo Steamboat Company, the visitors were greatly impressed by the completeness of the fittings and auxiliaries in the steamboat service. Probably the most interesting fitting out of this splendid line of boats was the electrical equipment on the steamer Eastern States, which conveyed the party from the Detroit & Buffalo company's docks, at Buffalo, to Detroit. This boat is 366 feet long, with 82-foot beam, 5,000 horsepower and 3,400 tons displacement, with an average speed of twenty-two miles per hour.

The dynamo room is equipped with Fuller & Company (Detroit, Mich.) Cornish style automatic engines, direct-coupled to six-pole 110-volt dynamos. Two sets are of 600 lights capacity each, and one set is of 300 lights capacity, for day service. Each dynamo has an automatic circuit-breaker on the switchboard so that it can not be overloaded, and the dynamos are so arranged that they can be paralleled if necessary.

The switchboard is connected to sixteen circuits, running to distributing cabinets located in convenient places throughout the ship, from which cabinets distributing boards with circuits of ten lights each are run. These circuits are controlled from these distributing cabinets by manual switches, so that the illumination can be arranged to suit the occasion by the cabin electrician.

There are about 1,100 lights throughout the ship, and electric call-bells are used from the various rooms and apartments. A 250-drop annunciator is located in the social hall.

The signal lights are electrically illuminated, with an automatic tell-tale located in the pilot-house, which indicates, by sounding the alarm, whether any particular light has failed to work during the time its service is called for. A 50,000-candle-power searchlight of the mirror projector type, equipped with regulation navy lens, is operated, and the boat is wired in strict accordance with the Great Lakes ship register rules. The regular navy style of ship wiring is practised throughout, and the regulation water-tight fixtures and junction boxes are used on all exposed work.

In the kitchen an electrical dish-washing machine is operated by a one-horsepower motor.

The Death of Mr. Albert Clarke White.

Mr. A. C. White, general manager of the Providence Telephone Company, died at his home in Providence, Friday night, June 27, of liver and heart trouble.

Mr. White was a pioneer telephone man, and one of the earliest to realize the great future of this industry. He always took a prominent part in the proceedings of the National Telephone Exchange Association, and was active in promoting telephone service along lines which took advantage of every improvement in apparatus and improvement in service methods. The new exchanges of his company in Providence and other cities in Rhode Island were models of their kind. Mr. White leaves a widow and six children, and his death will be mourned by a very large circle of friends, not only in Providence, but throughout the United States.

MR ALBERT CLARKE WHITE.

Mr. White would have been sixty-one years old on June 28. His first electrical work was as telegraph operator with the Western Union Telegraph Company, and he served as chief operator at Providence until he entered the telephone business in 1881. He took an active interest in public affairs, had been a member of the city council of his city and prominent in Masonic circles.

His funeral was held at the family residence on Tuesday of this week, at twelve o'clock. A number of electrical friends of the deceased from New York attended the services.

Iron is incandescent at 713 degrees Fahrenheit, gold gives out light at 783 degrees Fahrenheit, an electric light carbon at 734 degrees Fahrenheit. Chalk can be made to glow and give out light by an oxyhydrogen jet, as lime does in a calcium light.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ELECTRIC ROADS FOR ST. PETERSBURG—The Ministry of the Interior has approved the municipality's proposal to equip electrically the street railroads owned by the city, and the municipal authorities have been authorized to accept a favorable bid for their construction. It is said that an American firm will probably secure the contract.

ELECTRIC FREIGHT ROAD FOR LOUISIANA—The New Orleans & Southwestern Electric Railway Company, with a capital stock of $2,000,000, has been incorporated in New Orleans. The company will construct an electric railway line from New Orleans through the Louisiana sugar and rice districts, and when completed it will embrace a total mileage of some 200 miles. The road will be equipped to handle the heaviest kind of freight traffic, and the active work of construction will begin early in July. C. P. Sherer is the president; C. P. Young, general manager; H. L. Lancaster, treasurer, and Thomas A. Badeaux, secretary of the new company.

POSTAL GETS THE CONTRACT—The board of directors of the Pennsylvania Railroad Company have approved the contract with the Postal Telegraph Company for the stringing of wires along the line and the handling of the company's business. It is understood that it will take in all the lines of the company east of Pittsburg and Erie except that portion which was formerly known as the Western New York & Pennsylvania. The latter company has an agreement with the Western Union Telegraph Company for handling the business on its lines which will not expire until 1907, and unless other arrangements are made the Western Union Telegraph Company will continue its service on the Western New York & Pennsylvania road. The Postal Telegraph Company is to pay to the Pennsylvania Railroad Company $70,000 a year for the privilege of doing business on the line of the railroad, and is also to allow the railroad company a certain percentage of money received for commercial business. The railroad company, however, will be compelled to furnish the poles, while the telegraph company will supply the wires. This contract is to be in force for fifteen years, and is to apply to all lines of the company that have heretofore been operated by the Western Union Telegraph Company. The Western Union Telegraph Company has until December 1 to remove its wires, poles and instruments now on the line of the Pennsylvania Railroad, and it is understood that overtures are to be made to the telegraph company for the purchase of the wires and poles now on the company's right of way between New York and Pittsburg. The Pennsylvania Railroad Company has its own system between these two cities, but on the Philadelphia, Wilmington & Baltimore division the wires and poles belong to the Western Union Telegraph Company.

TELEPHONE AND TELEGRAPH

BRAZIL, IND.—The Citizens' Telephone Company, of Clay County, has been incorporated. The company will operate a telephone system in Brazil, the capital stock being $50,000.

CRESCENT, N. Y.—The Hudson River Telephone Company will construct an exchange at Crescent in a short time. The exchange will be worked from Crescent during the day, but in the evening the central will be at Cohoes, N. Y.

DENVER, COL.—Saguache, Rio Grande & Costilla counties will soon be equipped with a system of telephone lines. The Farmers' Union Telephone Company has been incorporated, with a capital stock of $10,000, to erect lines over these three counties.

TERRE HAUTE, IND.—The Citizens' Telephone Company will make a large addition to its switchboard, which now has a capacity of 1,220 lines. With the addition of the new board, an increase in the number of operators will be made to facilitate the service.

LEHIGH, UTAH—The Rocky Mountain Bell Telephone Company has reached Lehigh Junction with its new pole line. The telephone company has signed an agreement with the Utah Light and Power Company to join it in the erection of a single line of poles forty-five feet high through the main streets. These poles will be used conjointly.

WILMINGTON, DEL.—The Delaware & Atlantic Telegraph and Telephone Company is receiving material for extensive additions to its system of underground conduits in this city. It is estimated that the new work will add between six and seven miles of conduits. Work will be begun as soon as possible, permission having already been granted by the street and sewer department.

LAREDO, TEX.—The Southwestern Telegraph and Telephone Company has filed proceedings against the I. & G. N. for a right of way for the telephone line from San Antonio to Laredo over the railroad company's right of way. Work on the line will be commenced as soon as arrangements can be made, it being understood that telephone connections with San Antonio will be made by September 15.

ALAMOGORDO, NEW MEX.—Franchises have been granted for a telephone system for Alamogordo and Otero County, one of the conditions being that the line be extended to Cloudcroft and El Pano within a year. The company which proposes to construct and maintain the system will have the work completed and the telephones ready for use, it is said, in Alamogordo in ninety days. The franchise is for forty years, and the company is to pay the county $500 each year. An automatic system will probably be installed.

ELECTRIC LIGHTING

EMPORIA, KAN.—It has been decided to expend considerable money for improvements on the Emporia electric plant. The old building is to be improved and new dynamos are to be put in.

HAVERHILL, MASS.—The Haverhill Illuminating Company has filed certificates of incorporation with the Secretary of State, with a capital of $150,000. The company proposes to build a plant at Haverhill.

INDIANAPOLIS, IND.—The Indianapolis Light and Power Company's plant will be very much extended and improved, and when completed about 3,000 more horsepower will be added to the capacity of the plant.

OSWEGO, N. Y.—The Oswego Electric Light Company has been organized with a capital of $50,000. The company will manufacture and produce electricity for lighting, heating and power purposes. The directors are Charles G. Holleran, John D. McRae and John P. Miller, of Oswego.

ALAMOSA, COL.—The Mutual Electric Light and Power Company, composed of Alamosa citizens, has closed a deal, purchasing for $5,000 the plant, franchise, poles, wires, and good will of the old companies. The new company will not use the old plant, but bought it in order to have a clear field for the new enterprise, the plant of which they will erect within the next sixty days.

GREENFIELD, MASS.—The Greenfield Electric Light and Power Company will probably furnish the power to run the Northampton, Deerfield & Greenfield electric road when it is in operation. It may also furnish power for the whole or a part of the Northampton & Amherst road. The new water power which this company has secured will be located at West Deerfield, and it is estimated that the cost of the plant will be $100,000.

HOUSTON, TEX.—The Houston Lighting and Power Company is making considerable improvements. The foundation of the new building has been completed and a more extended service is being prepared to meet the demand which has become very urgent. The new machinery now being installed will add 1,500 horse-power, with appliances that will enable an addition of 1,500 horse-power more to be made when the demands of the business should require, making a total addition of 3,000 horse-power.

SYRACUSE, N. Y.—The Syracuse Lighting Company has under consideration the expenditure of $250,000 this year in making further improvements at its electric light station in this city. Since January, 1900, more than $500,000 has been expended in improvements, and the volume of business has more than doubled. Besides lighting the town streets, the company is furnishing light to many business houses and residences. A contract has been made to furnish street lights for the town of Eastwood, and many residences there are being lighted.

ELECTRICAL SECURITIES

The shock occasioned by the illness of the British King did not materially unbalance the market and financial conditions have shown a remarkable stability and resistance to disastrous predictions. The almost complete failure to induce liquidation of any moment in spite of unfavorable general developments or aggressive bear campaigns; the recent failure of the bear campaign inaugurated on the coal strike being points significant of such strength. Another important point is the outlook that the coal strike situation will shortly show improvement and the general acceptance of the views of the operators that the bituminous miners will not join in a general sympathetic strike. A big bull point is also to be found in the crop outlook, especially the promise of a big corn crop and a handsome cotton yield. Other bullish arguments are to be found in the general commercial and trade activity and prosperity, especially as regards the iron and steel industry and the transportation business, with a steady aggregate increase of earnings being reported from the latter in spite of some individual exceptions.

ELECTRICAL SECURITIES FOR WEEK ENDING JUNE 28.

New York:	Closing.
Brooklyn R. T.	67⅝
Con. Gas	220⅞
Gen. Elec	305
Kings Co. Elec	197
Man. El	131¼
Met. St. Ry	148½
N. Y. & N. J. Tel. Co	176
Westinghouse Mfg. Co	210

New York & New Jersey Telephone has been selling at 176 during the week. The telephone company has during the past week closed a contract for the erection of its new building. The structure is to cost $300,000 and will house Prospect Exchange, the Long Island Trunk line terminals, the repair shop and the supply department. The company's present building at Willoughby street, though a large one and recently erected, has already become too small and more room is demanded.

Boston:	Closing.
Am. Telep. & Tel	178
Edison Elec	277
Mass. Elec. pf	97½
New England Tel	147
Western Telephone & Telegraph	101½

The directors of the American Telegraph and Telephone Company have declared the regular quarterly dividend of 1½ per cent and ¾ per cent extra, payable July 15. The dividend record of American Telephone and Telegraph is: In 1900, 3 per cent and ¾ per cent extra; 1901, 6 per cent and 1½ per cent extra; this year, two quarterly dividends of 1½ per cent and one ¾ per cent extra.

Philadelphia:	Closing.
Elec. Co. of America	7¼
Elec. Stor. Bat. c	90
Elec. Stor. Bat. pf	90
Philadelphia Elec	5
Union Traction	44¼
United G. I. Co	108¾

United Gas Improvement and Union Traction were in demand during the week with a brisk outlook for the latter stock toward the close.

The directors of Electric Storage Battery have declared the regular quarterly dividends of 1¼ per cent on both the common and preferred stock, payable July 1 to stockholders of record on the closing of the books June 27.

The Rhode Island Company, whose $2,000,000 capital was subscribed by the United Gas Improvement Company, Philadelphia, has, it is understood, taken over under a 999-year lease the Union Railroad, of Providence, the Pawtucket Street Railway, and the Rhode Island Suburban Railway. These trolley lines are owned by the United Traction and Electric Company, the holders of whose $8,000,000 stock will receive under the lease dividends at the rate of 5 per cent per annum and presently in addition a distribution of 25 per cent ($2,000,000) in the stock of the Rhode Island Securities Company. This last-named company will shortly be organized with a capitalization consisting of $10,000,000 each of stock and bonds, to take over the $2,000,000 stock of the Rhode Island company, with its lease of the trolley lines, and also the proposed leases of the gas and electric lighting properties. The directors of the Rhode Island company are: President, Marsden J. Perry, Providence; vice-presidents, Samuel P. Colt, Providence; Randal Morgan and Walton Clark, Philadelphia; secretary-treasurer, Lewis Lillie, Philadelphia; Nelson W. Aldrich, William G. Roelker, J. Edward Studley, Howard O. Sturges, Walter F. Agnell, Samuel M. Nicholson, all of Providence, and Thomas Dolan, Philadelphia.

Chicago:	Closing.
Chicago Edison Light	179
Chicago Telep	170
Metropolitan El. pf	89
National Carbon	23
National Carbon pf	96
Union Traction	16⅞
Union Traction pf	50

PERSONAL MENTION

MR. A. A. SERVA, assistant manager of sales of the Fort Wayne Electric Works, Fort Wayne, Ind., was in New York and Philadelphia during the past week.

MR. CHARLES H. NORTH, president and general manager of the North Electric Company, of Cleveland, with his wife and two children, spent a few days in New York while en route from the Philadelphia Telephone Convention to Cleveland.

MR. DAVID SHANKS, of Handley & Shanks, electrical engineers of Birmingham, England, paid the ELECTRICAL REVIEW an agreeable visit on Monday of this week. Mr. Shanks spent some six weeks in this country, visiting leading electrical manufactories and installations. He sailed for home on Wednesday of this week.

MR. R. T. LOZIER, of the Bullock Manufacturing Company, who has had charge of the New York offices of this progressive electrical manufacturing company, leaves this week for the home office at Cincinnati where his sphere of responsibility has been considerably enlarged, and he takes charge in the capacity of general manager of sales. On Saturday of last week Mr. Lozier gave a farewell luncheon to a number of his electrical friends at the Lawyers' Club. It was a very pleasant affair and all united in extending cordial best wishes to the host, in which the ELECTRICAL REVIEW heartily joins.

ELECTRIC RAILWAYS

ST. LOUIS, MO.—The St. Louis, Clayton & St. Charles Railway Company has asked for permission to construct a railroad running from the Olive Street Road to the main line.

FORT WAYNE, IND.—The Fort Wayne & Southwestern Traction Company has filed notice in the Secretary of State's office of an increase in the capital stock from $600,000 to $1,000,000, and has amended articles to extend its lines from Fort Wayne to Goshen.

MUNCIE, IND.—The promoters of the proposed Muncie-Newcastle Interurban Line have petitioned the board of Normal City that the company desires a franchise for the right of way through the town. The right of way has also been requested from the city limits west to the county line.

TOPEKA, KAN.—The Kansas City, Vinewood Park & Topeka Electric Railroad has been granted a franchise to run its cars into this city. The franchise has been accepted, and a forfeit of $5,000 has been deposited with the city, guaranteeing that the cars will be running on certain streets by September.

AURORA, ILL.—As soon as material is on the ground, the construction of the Aurora & Rockford Electric Railroad will begin. A forty-year franchise for two streets has been secured by the company agreeing to pay $10,000 in cash to the city for the privilege, and also to put up indemnity bonds during the course of construction of the road.

EASTERN PENNSYLVANIA, N. J.—The Eastern & Washington Traction Company has secured a franchise to build an electric railroad in Eastern Pensylvania and Washington, N. J., making forty-five miles of road connecting this city with all near-by New Jersey towns of any prominence. The charter cost $25,000 and was taken out at Trenton, N. J.

INDIANAPOLIS, IND.—The Indianapolis & Plainfield Electric Line has begun laying its tracks in West Indianapolis. A large force of men is at work, and it is expected that operations will begin in forty days. The Indianapolis Street Railway Company will extend its line to the belt line, thus connecting with the Plainfield line, giving direct access to this city.

DES MOINES, IOWA—It has been announced that the electric interurban line now building from Waterloo to Denver will be completed to Tripoli, Bremer County, on the Great Western this summer, and when the Great Western completes its lines from Oelwein to Waverly, the Summer-Waverly will be abandoned and sold to the electric road to be operated by it.

INDUSTRIAL ITEMS

THE CHICAGO TELEPHONE SUPPLY COMPANY purposes to remove its factory and offices about September 1 from Chicago to Elkhardt, Ind.

THE FALLER AUTOMATIC TELEPHONE EXCHANGE COMPANY is exhibiting its system at 22 Union Square East, New York city. This system was illustrated and described some weeks ago in these columns.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, has recently been awarded a large contract for arc lamps for Washington, D. C., through the Doubleday-Hill Electric Company, Pittsburg, Pa., its Pennsylvania agents.

THE REUTERDAHL ELECTRIC COMPANY, Providence, R. I., has opened a New York office at 70 Trinity Place. Mr. H. M. Williams is in charge. This company manufactures the Reuterdahl storage battery which has become well known and is well endorsed by users.

THE STANLEY INSTRUMENT COMPANY, the office and factory of which are located at Great Barrington, Mass., and the sales department at 146 Broadway, New York city, has issued a unique little folder on "Magnetic Flotation." This is a clever sketch of the history of this subject.

THE EUREKA ELECTRIC COMPANY, Chicago, Ill., is placing before the telephone public the Grigg's adjustable swinging telephone brackets for desk telephone service, and is also calling attention to its handling of Hind's telephone lease record. These two specialties have become very popular in the telephone field.

J. G. BRILL COMPANY, Philadelphia, Pa., is distributing a splendid catalogue describing its perfectly equalized steam and electric passenger trucks. Under separate headings the frames, equalizing bars, springs and brakes are described, and the book is made complete with half-tone and diagrammatic illustrations.

M. B. AUSTIN & COMPANY, Chicago—Mr. Joseph Franklin, Jr., who is well known in the West through his being president of the Commercial Electric Supply Company, of St. Louis, has recently acquired stock in M. B. Austin & Company, of Chicago, and immediately assumed the management of sales for this company.

THE OTIS ELEVATOR COMPANY announces the recent closing of contracts for more than fifty electric passenger elevators in New York city and vicinity, forty-five of which will be installed in New York city proper. Further recent contracts cover installations for elevators to be installed in Yokohama, Japan; Melbourne, Australia, and Buenos Aires, South America.

FERGUSON & GOODNOW, 100 Washington street, Chicago, Ill., announce that the property of the United States Accumulator Company, which failed a short time ago, is for sale. The property is located at 212 East Illinois street, and can be seen by notifying this office or Henry L. Wilson, the receiver, at the First National Bank Building.

ARNOLD MAGNETIC CLUTCH COMPANY, Milwaukee, Wis., has been recently organized to manufacture the Arnold magnetic clutch. Within ninety days the company expects to have a well equipped factory in operation. The officers of this new company are: president, F. R. Bacon; vice-president, H. H. Cutler; secretary, A. W. Berresford; treasurer, F. L. Pierce; consulting engineer, Bion J. Arnold.

THE BROOKFIELD GLASS COMPANY, New York, the long-time established manufacturer of glass insulators for electrical work, announces that it is equipped for the manufacture of insulators for high-potential electric power transmission. Special designs for particular work will be made on request. The company's offices are at 218-220 Broadway, and its extensive works are located in the Borough of Brooklyn.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago, Ill., received ten gold medals, four silver medals and four bronze medals for its various products from the South Carolina Interstate and West Indian Exposition, which closed at Charleston, S. C., May 31. The company received also the Diploma of Merit for its installation in the Commerce Building. The medals awarded were the highest awards in each class.

THE SAN GABRIEL ELECTRIC COMPANY, Los Angeles, Cal., has recently purchased a 750-kilowatt, two-phase, engine-type Westinghouse generator, which is to be installed in a substation of the Pacific Light and Power Company. The latter company has recently acquired the San Gabriel company, and the new alternator will be used in connection with its general system of lighting and power in Los Angeles and the vicinity.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee, Wis., is now distributing its catalogue No. 51, descriptive of motor-driven air compressors of the stationary and portable types. These motor-driven air compressors were comprehensively described in a recent number of the ELECTRICAL REVIEW, and the catalogue furnishes sizes and weights which are supplemented by additional descriptions and improvements since that time.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is just out with one of the handsomest, most comprehensive and best arranged electrical supply catalogues ever sent to the trade. This catalogue is No. 16 and is accompanied by an up-to-date loose leaf net price list and discount sheet. This is so arranged that as prices change new leaves may be inserted. The compilation is a distinct advance over previous issues and is certain to meet with favor by buyers and users of electrical goods.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., is the original patentee and sole manufacturer of genuine lava insulation. To protect the user from imitations which are not of its manufacture, the company has bought a new name and trade-mark, "Lavite," which will be used to distinguish its product in the future. The company has recently established a permanent branch office at 57 Washington street, Chicago. This was started as an experiment in March and the results have been so gratifying that the company feels constrained to continue it as a fixture in the future.

ALBERT STEPHANY, receiver, Atlantic Supply Company, Atlantic City, N. J., advises us as follows: "I receive large quantities of circulars and other advertising matter which dealers continue to send to the company, very likely at quite an expense. As the company will not again be open for business, it seems useless to have this company's name continue on the mailing lists, yet to constantly notify the senders of the same would unnecessarily add to the expense of the settlement of the affairs of the company. I shall therefore appreciate any notice which you may give your readers of the fact."

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, is placing a new telephone switchboard on the market, regarding which is made many claims of superiority. The combined drop and jack is of novel construction. The excellence of this device is claimed not only to lie in the general mechanical design, but by reason of the armature being mounted on the front end of the coil, and the manner in which it is constructed, the highest electrical efficiency is said to have been attained. From extensive tests it has developed that only one-fortieth of the electrical energy is necessary to operate this drop that is required by others. From the numerous orders and enquiries that it is receiving it is apparent that the trade at large is convinced of the genuineness of the claims. The simple construction of this combined drop and jack and the extremely slight electrical energy required to operate it, appeal very strongly to the practical telephone man. Combining these features with the compactness and general high-grade construction of this switchboard, it becomes of special interest to telephone engineers who have noted the progress and the improvements made in telephone apparatus tending to a higher state of perfection and efficiency. It will be noticed that the manner in which the armature is placed is a decided departure from other devices of this kind. The drop shutter, when in the retained position, rests squarely upon the armature itself, the manufacturer having completely done away with the rod that is customarily used for holding the shutter in place. The armature does not operate on any hinge, but rests on its own weight on a knife edge at the bottom, which is on the principle of the most accurate weighing devices in common use The space occupied by the complete structure, comprising the combined drop and jack, is only one by one and one-half inches, which makes this switchboard very compact. With the company's mechanical restoring device, positive in its operation, it is claimed that this board is the most rapid in service of any in use.